VOCATIONAL TEACHERS OF AGRICULTURE IN NORTH CAROLINA

The opening paragraphs of an article "Teachers of Agriculture in North Carolina" by J. B. Britt, Chancellor of the University of N. C. published in *Quarterly of Alpha Zeta*, April, 1928, states so succinctly the opportunities of agricultural teachers that we reprint them. As to what an agricultural teacher may do Chancellor Britt might have been writing of the Philippines instead of North Carolina, so well does he visualize the field.

In the South agriculture has made progress that has been slow but surely a growth that is phenomenal within the last twenty years.

Trained agricultural leadership has been largely responsible for this growth. It has taken time and energy to establish leadership that was sound, scientific, and presented in a way that the farmers of the South would follow.

This achievement has been such that the workers should feel a just pride in their accomplishment.

Great progress has been made, especially in the field of vocational agriculture. A form of leadership in which the highly trained specialist gives to the high school boy a training that is both thorough and practical. The student receives both the theory and demonstrated practice of scientific agriculture. In the vocational agriculture scheme of instruction, not only does the son of the farmer receive training, but the father of the high school boy receives instruction in evening classes on the approved methods of doing things. Thus it is not necessary to wait for a new generation to grow to maturity for a better method of farming to be installed. Rather the result is immediate and effective.

Up to the present time the demand for vocational agriculture teachers has been greater than the supply. The southern farmer is realizing more and more the value and place of the agricultural teacher in the high school.

Not only does the vocational teacher give instruction to his class but he also becomes a community leader, an organizer of community fairs, cooperative organizations for the general upbuilding and betterment in the community. Interest in good roads, young people's organizations, are found to be popular by-products of the agricultural teacher's work.

It is true the agricultural teacher's job is primarily that of instructing in the class room. His leadership does not stop there for he occupies an unique place in the community by being in the position to assume leadership in building a rural life in which there is progress in every respect.

It is exceedingly gratifying to those in charge of vocational work in the South and those concerned about the rural welfare and development to know that the great majority of agricultural teachers are contributing to the growth of a better agricultural condition. Besides class room and evening class instruction it has been found by careful records that the teachers have contributed to rural welfare by assisting in the annual rally of the school, assisting farmers in purchasing fertilizer and pure bred live stock; serving as chairmen of an agricultural committee; promoting strawberry and watermelon associations; conducting a community crop project to produce funds to help pay for the maintenance of the vocational agricultural work; conducting motion picture shows on Saturday nights; holding picnics; conducting young men's Sunday School classes and Bible classes; acting as president of the county teachers' association; superintending county fairs; producing cabbage plants and other seedlings for the patrons of the school; assisting the farmers in the marketing of their products; surveying the counties and the communities in which they reside in order to obtain information to place before advisory committees; conducting educational tours of the farmers to the state agricultural college, assisting the Chamber of Commerce in a close cooperation between farmers and rural pupils and many other activities of like nature.

One immediately says that to do all this requires scientific training, energy, initiation, and tact. This is true. But the utilization of these four factors has been responsible in a large measure for the progress of the Southern states in the agricultural field.

It is impossible to estimate the financial value of the services of the agricultural teachers to their communities. It is estimated that some of the teachers increase the earning of the farmers that they work with approximately $500 per farmer. These increases are obtained by the use of better seeds, a saving in time and in quality of fertilizer purchased, and cooperation in selling the produce.

Who can measure the money value of a cooperatively working community in which there is pride shown in the quality of crops grown, the quality of live stock produced, pride in school and church work, in fact an entire community working harmoniously for rural welfare and progress? This is the job that the agricultural teacher has set himself to do.

The Alternative—Research or Retrogression.

—*Forbes Magazine.*

A REPORT ON THE ASEXUAL INHERITANCE OF "MANY-EYED' CHARACTER OF SUGAR CANE[1]

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WITH TWO TEXT FIGURES

INTRODUCTION

One of the many characters which the plant breeder desires to improve in the sugar cane plant is the percentage of "germination" of the eyes. A good germination means less expense and lower cost of production than a poor germination. The ability of a cane to germinate well depends, among other things, on the number and vigor of the eyes at each node. Usually there is only one such eye. Unquestionably, a node containing more than one eye will have a higher germinating ability than one with only a single eye. Occasionally stalks are encountered possessing more than one eye at each node.

Observed cases of bud variations on sugar cane with reference to the eye

Variations of sugar cane stalks with respect to the presence or absence of eyes, irregular occurrence of single and double eyes in a stalk, and branching of stalks have been observed. A description of these reported abnormalities follows:

A stalk with short joints. A stalk with very short joints, each node having two eyes diametrically opposite, was observed on Yellow Jamaica variety by F. Serban in Lima, Peru.[2]

A stalk with eyes on each node at right angles. A stalk with two eyes in each joint, the eyes alternating at right angles at every other joint was found in the island of Kauai by Mr. Geo. H. Fairchild (1926) and mentioned in one of his letters to Dr. N. B. Mendiola of this College.

Eyeless nodes. When the Plant Breeding Division of this College raised its batch of sugar cane seedlings in 1922-1923, a stool was found with all its nodes eyeless. It consisted of five stalks. Good care was given to the plant, but later on it died. Figure 1 (*d*) gives an example of this character.

Branching. Branching was first observed by the writer in the cultures of the Pampanga Sugar Mills while working in that place from December,

[1] Experiment Station contribution No. 551. Prepared in the Department of Agronomy under the direction of Dr. N. B. Mendiola. Report read before the Los Baños Biological Club, September 6, 1928. Received for publication September 7, 1928.

[2] The Planter and Sugar Manufacturer, March 6, 1909.

1926, to February, 1927. A similar case was reported by Labrador (1927)[3] of the Bureau of Agriculture in La Carlota Experiment Station, Occidental Negros. An example of this case is shown in figure 1 (*a*).

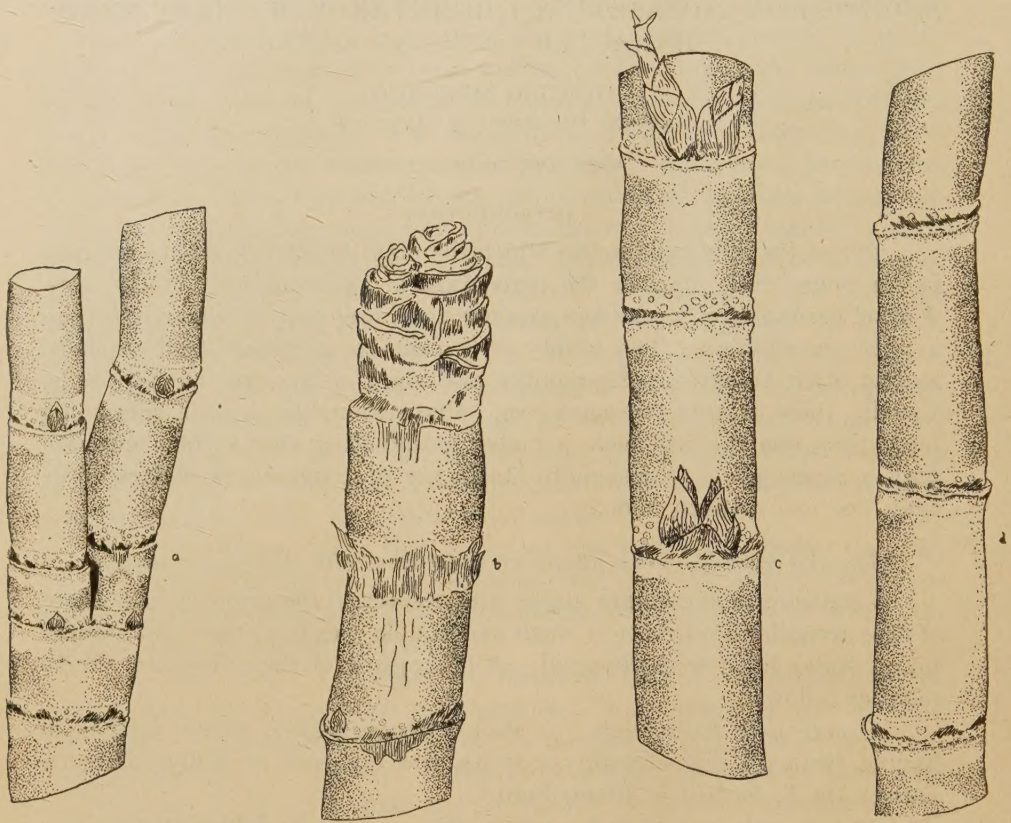

Figure 1.—Observed cases of bud variations on sugar cane with reference to the eye. *a.*—Branching stalk; *b.*—Portion of stalk with multiple buds on top; *c.*—Portion of a stalk with double eyes in a node; *d.*—Eyeless stalk.

Double eyes. Another interesting abnormality found among sugar canes was a stalk with a row of double eyes at one side and a row of single eyes at the other, formed throughout the entire stalk. It was observed in a stool of P. B. 117, one of the seedling canes raised in this College. (See figure 1 (*c*)).

Multiple eyes. More than five eyes in a node were found at the upper end of a stalk of Mauritius Malagache variety. It was observed among the ratoon canes at the beginning of the wet season in May, 1927. (See figure 1 (*b*)).

[3] Labrador, A. 1927. A case of teratological twinning in sugar cane. The Philippine Agricultural Review: **20**: 2: 289.

Top of flowering stalks found eyeless. It was observed that at the end of a flowering stalk several nodes did not produce eyes. Below the eyeless nodes, joints with one eye each were found.

Object of the present work

The object of the work here reported was to find the degree of asexual inheritance of "Many-eyed" character of a cane stalk.

Time and place of the work

The work was conducted in the College of Agriculture Plant Breeding Garden from June, 1927, to March, 1928, covering a period of ten months. This report includes one asexual generation of the cane studied.

MATERIALS

Description of the mother cane plant used

This cane is a seedling cane of Badila parentage. It is a purple cane, with medium sized stalks, semi-erect, with fair tillering habits, and cracks sparsely. The internodes are medium in length, normal in shape, with a thick glaucous band, and large and prominent eyes, one or more of them being at each node. A study of the "Jeswiet hair groups" of one pair of these eyes showed that they have identical hair groups.

Methods of observation

It was in June, 1927, that the material used in this study was found among the naturally selfed Badila seedling cane varieties raised during the 1925-1926 season. The four stalks which constituted the plant were taken to the laboratory for study. Each node in each stalk was numbered consecutively from the top of the stalk downward. The eyes found in each node were counted. They were planted in seed boxes and the shoots that developed were noted and transplanted in the Plant Breeding Garden. During the growing period of the plants, they were given similar treatment as to cultivation and fertilization. Ammonium sulfate was applied to the planting once.

Germination test

The field germinating ability of the cane variety was compared with that of Luzon White, one of the commercial native varieties in Los Baños. All available points, excluding body cuttings, were used in this study. Two points were taken from each stalk. All the points from one stool were planted separately from the points of the other. Two hills were used as check for each group of cuttings from one original stool. Two points of Luzon White were planted in each hill while one cutting of the "Many-eyed" variety was used to a hill. Before planting, all the points were treated in the same way. They were soaked in water for forty-eight hours and

were kept in the germinating shed for a week. Five weeks after planting the percentage of germination was taken.

RESULTS

The results of this work are given in tables 1 to 6.

Table 1 gives the number and percentage of nodes with one, two, and three visible eyes, found in each original parent stalk.

Table 2 gives the percentage of germination of the single, double, and triple eyes separately. The percentage is found by dividing the number of shoots produced by the number of nodes and the quotient multiplied by one hundred.

In table 3 is found the total production of single, double, and triple eyes, separately.

Table 4 presents the percentage of single and multiple eyes, both in the parent and offspring.

Table 5 gives the comparative germination test of "Many-eyed" variety versus Luzon White.

Table 6 presents the hair groups of the twin eyes.

DISCUSSION OF RESULTS

Percentage of one, two, and three visible eyes in each stalk

It will be seen in table 1 that the percentage of nodes with one visible eye in the node of the four original stalks studied ranged from 53.33 to 68.1, giving an average of 60.52. The percentage of the nodes with two visible eyes each varied considerably from 9.09 to 33.33, the average being 26.43. The nodes with three visible eyes each were few in number as compared with those of one or two eyes each. It ranged from 6.06 to 22.7 per cent. It is of interest to note the ratio of the single, double, and triple eyes. The first stalk gave a ratio of 2 : 1 : 1/5 or 10 : 5 : 1; the second stalk, 2 : 1 : 1/3 or 6 : 3 : 1; the third stalk, 7 : 1 : 2; and the fourth stalk, 2 : 1 : ½ or 4 : 2 : 1. Of the 114 original nodes studied, 69 nodes had one single visible eye, 30 had double visible eyes, and 15 had three visible eyes, giving a total ratio of 2 : 1 : ½ or 4 : 2 : 1.

TABLE 1

Percentage of one, two, and three visible eyes in each parent stalk

STALK NO.	NUMBER OF NODES STUDIED	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
		number	*per cent*	*number*	*per cent*	*number*	*per cent*
I	33	20	60.60	11	33.33	2	6.06
II	29	18	62.00	8	27.56	3	10.34
III	22	15	68.10	2	9.09	5	22.70
IV	30	16	53.33	9	30.00	5	16.60
Total	114	69	60.52	30	26.43	15	13.15

Germination under nursery conditions

In table 2 it may be seen that the percentage of germination of nodes containing the three visible eyes is much higher than that of the nodes with two visible eyes, and very much higher than that of the nodes with a single eye each. Some of the nodes gave over 100 per cent germination. This difference may be explained by the fact that in most cases some invisible eyes developed into shoots. Stalk I gave 70.0 per cent of germination of nodes with single eye each, 145.45 per cent with double eyes, and 200 per cent with triple eyes. Stalk II gave 88.89 per cent of germination of nodes with single eye, 162.5 per cent with double eyes, and 200 per cent with three visible eyes. Stalk III gave 100 per cent germination of nodes with single eyes, 200 per cent with double, and 260 per cent with triple. Stalk IV gave 106.25 per cent of nodes with single eye, 155.56 per cent with double, and 100 per cent with triple. Of the four stalks studied, there was an average of 91.29 per cent of germination of nodes with single eyes, 165.88 per cent with double, and 190 per cent with triple, grown under nursery conditions.

TABLE 2

Percentage of germination

STALK NO.	NODES WITH ONE VISIBLE EYE			NODES WITH TWO VISIBLE EYES			NODES WITH THREE VISIBLE EYES		
	Number	Shoots found	Percentage of germination	Number	Shoots found	Percentage of germination	Number	Shoots found	Percentage of germination
I	20	14	70.00	11	16	145.45	2	4	200
II	18	16	88.89	8	13	162.50	3	6	200
III	15	15	100.00	2	4	200.00	5	13	260
IV	16	17	106.25	9	14	155.56	3	3	100
Average			91.29			165.88			190

Hereditary behavior of single and multiple eyes

In table 3 may be seen the hereditary behavior of the character under study with reference to single and multiple eyes. It is evident that single or double eye characters are not always asexually inherited. The occurrence of the multiple eyes is inherited from the parent in nodes with one visible eye each as well as in nodes with double or triple eyes. As shown in the upper section of table 3 the nodes with a single eye each produced true to their original character, yielding 85.57 per cent, but produced 13.52 per cent with two visible eyes, and 0.90 per cent with three visible eyes. The nodes with two visible eyes yielded fewer nodes with a single eye than parent nodes with only one eye each, but more nodes contained double and triple eyes. This is shown in the middle section of the same table. Of the 390 nodes, 81.03 per cent were with single visible eye, 17.95 per cent with double visible eyes, and 1.025 per cent with three visible eyes. The third section of the same table shows that there was a production of 80.04

per cent of single eyes from nodes with three visible eyes, 18.82 per cent with double eyes, and 1.33 per cent with triple eyes. However, the production of nodes with double or triple eyes was much higher than that of the nodes from single or double eyes.

TABLE 3

Production of multiple eyes
From nodes with only one visible eye to the node

ORIGINAL STALK NO.	NODES STUDIED	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
		number	*per cent*	*number*	*per cent*	*number*	*per cent*
I	499	452	90.58	43	8.61	4	0.80
II	477	424	88.88	48	10.06	5	1.04
III	403	313	77.66	86	21.34	4	0.99
IV	174	140	80.46	33	18.96	1	0.57
Total	1553	1329	85.57	210	13.52	14	0.90
		From nodes with two visible eyes to the node					
I	46	37	80.43	8	17.39	1	2.17
II	119	105	88.23	13	10.92	1	0.84
III	113	98	86.72	13	11.504	2	1.77
IV	112	76	67.85	36	32.14	—	——
Total	390	316	81.03	70	17.95	4	1.025
		From nodes with three visible eyes to the node					
I	63	57	90.47	6	9.52	—	——
II	97	85	87.63	12	12.37	—	——
III	265	199	75.09	61	23.02	5	1.89
IV	16	12	75.00	4	25.00	—	——
Total	441	353	80.04	83	18.82	5	1.13

Comparing the hereditary production of single and multiple eyes by the four original stalks it may be noticed that in general there was an increase in the number of nodes with one visible eye, and very marked decrease in multiple eyes. This is shown in table 4. Stalk I with 60.60 per cent of nodes with single eye, 33.33 per cent with double eyes, and 6.06 per cent with three visible eyes had in the next asexual generation 89.8 per cent nodes with single eye, 9.3 per cent with double eyes, and 0.82 per cent with triple eyes. The progeny of stalks II and IV also showed an increase in single eyes, and decrease in double and triple eyes. The offspring of stalk III had a similar increase in yield of nodes with single eye, but yielded more nodes with double visible eyes. It also gave a relative decrease of nodes with triple eyes. The parent nodes with 71 per cent single visible eye gave in the following generation 83.00 per cent nodes with one eye; the parent nodes with 25.02 per cent single eye gave 16.14 per cent of nodes with two eyes; and the 13.97 per cent nodes with single eye gave 0.84 per cent nodes with two eyes.

TABLE 4

Comparative production of multiple eyes

STALK NO.	NODES WITH ONE VISIBLE EYE		NODES WITH TWO VISIBLE EYES		NODES WITH THREE VISIBLE EYES	
	Parent	Offspring	Parent	Offspring	Parent	Offspring
	per cent	*per cent*	*per cent*	*per cent*	*per cent*	*per cent*
I	60.60	89.8	33.33	9.3	6.06	0.82
II	62.00	88.6	27.66	10.53	10.53	0.86
III	68.10	78.1	9.09	20.48	22.70	1.40
IV	53.30	75.48	30.00	24.24	16.60	0.27
Average	61.00	83.00	25.02	16.14	13.97	0.84

Field germination test of "Many-eyed" variety versus Luzon White

While the points of the two varieties compared were in the nursery, it was observed that the "Many-eyed" variety germinated earlier than the Luzon White. This may be explained by the fact that the "Many-eyed" variety has more and larger eyes than the Luzon White. The points of Luzon White started to germinate two days later than those of the "Many-eyed". Under field conditions the "Many-eyed" variety germinated well.

As shown in table 5 the "Many-eyed" variety gave a higher percentage of germination than Luzon White in spite of the fact that two points of Luzon White were planted in a hill, while only one point of "Many-eyed" was used. Stalk I with 120 points gave a field germination of 86.66 per cent, while the check representing Luzon White had only 77.5 per cent. Stalk II with 141 cuttings had 69.60 per cent of germination and the check only 54.12 per cent Stalk III of 160 points gave 91.25 per cent germination and the check with 28 points had only 78.57 per cent. The check of stalk IV with a germination of 100 per cent had only 77.27 per cent. Luzon White gave an average germination of 71.87 per cent, while the "Many-eyed" variety had 86.88 per cent. These data clearly show that the "Many-eyed" germinated better than the Luzon White variety.

TABLE 5

Comparative germination test of the "Many-eyed" and Luzon White variety of sugar cane

ORIGINAL STALK NO.	NUMBER OF HILLS PLANTED	NUMBER OF HILLS GERMINATED	PERCENTAGE OF GERMINATION
Stalk I	120	104	86.66
Luzon White (check)[a]	40	31	77.50
Stalk II	141	88	69.60
Luzon White (check)	24	13	54.12
Stalk III	160	146	91.25
Luzon White (check)	28	22	78.57
Stalk IV	15	15	100.00
Luzon White (check)	44	34	77.27
Average germination of "Many-eyed" variety			86.88
Average germination of Luzon White			71.87

[a] For check using Luzon White two points were planted in each hill.

Jeswiet study of hair groups of twin eyes

As shown in table 6 hair groups, numbers 1, 2, 3, 6, 12, and 17 are found in most of the bracts of the twin eyes studied except group number 17 which is absent in bract number 4. There are, however, numbers 4, 5, 15, and 16 which are found in different bracts. It may be noted that upon dissection of the twin eyes a small eye was also found. The hair groups were so minute that few of them were drawn. Group numbers 1, 2, 3, 6, and 12 are found in this small eye.

TABLE 6

Hair groups found in twin eyes of "Many-eyed" variety

BRACT NO. 1		BRACT NO. 2		BRACT NO. 3		BRACT NO. 4		BRACT NO. 5		BRACT NO. 6		
Left	Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	Middle	Right
1	1	1	1	1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3	3	—	3	—
4	—	—	—	—	—	—	—	—	4	4	—	—
—	—	—	—	5	5	—	—	—	—	—	—	—
6	6	6	6	6	6	6	6	6	6	6	6	6
12	12	12	12	12	12	12	12	12	12	12	12	12
15	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	16	16	16	—	16
17	17	17	17	17	17	—	—	17	17	17	—	17

SUMMARY AND CONCLUSIONS

1. In this "Many-eyed" seedling cane variety double or multiple eyes were found in different nodes of the stalks. This is shown in figure 2. The visible eyes in the nodes did not necessarily mean the actual number of eyes present in the nodes. Sometimes there were small eyes hidden near the visible eyes.

2. In the same variety the percentage of germination of nodes with multiple eyes was considerably higher than that of the nodes with one eye each. The field test of this particular cane gave a relatively high percentage of germination. Under nursery and field conditions the "Many-eyed" variety germinated earlier than Luzon White. The "Many-eyed" with only one point to the hill gave a germination of 86.88 per cent, while Luzon White with two points in a hill gave only 71.87.

3. In this cane a parent node with one single bud did not produce only the single eye characteristic; it also produced multiple buds. Similarly, nodes with multiple eyes produced single, double, and triple eyes as well.

The parent plant had a ratio of 4 : 2 : 1 of single, double, and triple eyes, respectively. In the following generation there was found a ratio of 5.04 : 1.00 : 0.06 or 504 : 100 : 6 of single, double, and triple eyes, respectively.

4. In the first asexual generation there was an increase in the production of single eyes but a decrease of nodes with multiple eyes.

Fig. 2.—A stalk of "Many-eyed" variety of sugar cane showing the number of shoots produced by the different nodes.

5. Should the increase in the percentage of single eye continue in the following generations, the cane should become ultimately a one-eyed variety. On the other hand, should this variety continue to produce multiple eyes in the succeeding generations, its germination would be faster and greater than the Luzon White.

6. Twin eyes in a node of this variety have usually similar hair groupings, varying only in very few cases.

OUR FARM LABOR SUPPLY[1]

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There are in the Philippines about 5,000,000 hectares of uncultivated agricultural land, which is about 19 per cent of the total area of the country. The cultivated area, about 3,703,700 hectares, or 12.5 per cent of the whole, is the source of the bulk of the income of the country. But even with this comparatively small area under cultivation agricultural labor is inadequate. The Bureau of Labor reports that in 1925 out of 2,857,401 laborers engaged in all the industries in the country, 2,547,572, or 89.15 per cent of the total were agricultural laborers. This number gives an average of less than one laborer to every hectare of the cultivated land. Of this total number of agricultural laborers only 1,594,360 were men, the rest were women and boys and girls.

TABLE 1

Showing the total wage earners in the Philippine Islands classified as males, females, and minors, by occupational groups [a]

OCCUPATION GROUP	TOTAL	WAGE EARNERS		
		Male	Female	Minors
Agricultural	2,547,572	1,299,154	607,176	641,242
Fishing industry	50,830	50,307	99	424
Forestry	11,763	11,677	———	86
Trade and Industries	113,171	99,568	11,624	1,979
Mines	3,037	3,032	———	5
Commerce and Transportation	118,178	117,845	329	4
Employees of the Insular Government	12,850	12,777	62	11
Total	2,857,401	1,594,360	619,290	643,751

[a] From the Philippine Bureau of Labor Bulletin 26: 30. Issued March, 1927.

This shortage of farm hands is a serious situation not only for the farmer but for the industries as well. We can not expect to depend upon farm-labor-saving machines for many years to come as their use in this country under the present conditions is very expensive and, in most cases, far from being practical. We will, therefore, continue to demand human labor, both men and women, to help produce the agricultural crops, most of which are necessary for our existence. Our present problem then is to

[1] General contribution from the College of Agriculture, No. 210. Received for publication July 5, 1928.

effect a uniform distribution of agricultural labor throughout the farming communities and to devise ways by which the future demand for such labor can be supplied.

Why is there a shortage of farm labor? Why is this shortage more serious in some parts of the country than in others? How can this condition be improved? These are some of the questions to be considered.

Before satisfactory answers can be given to these questions inquiry must be made into the different phases of our agricultural labor supply. The agricultural labor conditions in the Islands must be considered.

SOURCES OF AGRICULTURAL LABOR SUPPLY

The labor supply of a country comes from two general sources: namely, (1) native population; and (2) immigration. Agricultural labor supply is no exception. Let us consider these sources of labor supply as applied to Philippine agriculture.

Native population

Our native farm hands are made up of two groups. One group is the sons of farmers who remain and work on the farm with a view to owning land and becoming independent farmers. This group of agricultural laborers, according to Ely, retains its social position because laborers belonging to it are treated in the same way as their fathers. It is the most desirable class of farm hands. Unfortunately, in the Philippines there is a constant drain on the number of farm laborers from this class. The desire for education and the attractions of city life, supported by the unwise ambition of the Filipino father to see his son have what he thinks is an easier job than his own, has taken many sons of farmers away from the country to the large towns and cities. These boys seldom return to the farm. Moreover, for the most part, it is the best of the young men that leave the farms. Those with the poorer qualifications, both mentally and physically, are too often the ones who stay in the home barrios. The result is that the general intelligence of our rural population remains at a standstill, a condition which makes it very difficult to persuade the farmers to change their old methods of farming.

The second group of native farm hands consists of those migratory or casual agricultural laborers who drift from city to country and back again, or from one occupation to another. The laborers belonging to this class form the great majority of our farm hands. Fortunately for us, most of our laborers from this class are from crowded rural communities; consequently, with proper encouragement many may be induced to settle permanently upon the land.

As the local agricultural laborers in many regions are far from being sufficient, the migratory laborers from densely populated districts should be encouraged to go where there is a demand for them. There is a surplus

labor population in the most densely populated provinces of the Archipelago, but there is no effective organized method to move them to the communities where there is a shortage of labor, especially at certain seasons.

Director Cruz (1927) of the Bureau of Labor in speaking on Labor Recruiting says that the Philippine Islands has about 3,000,000 persons available for agricultural work, or 25 per cent of the whole population. He further states that the country has 600,000 migratory laborers, a number large enough to meet the needs of the farmers provided there was an effective method of distribution.

The seasonal migration of farm laborers in the Philippines is natural, and is due principally to the unequal distribution of our population and the cultivation of seasonal crops which are highly specialized in certain regions. The surplus labor in the most densely populated regions is forced to go to places where there is demand for labor. As the seasonal crops are planted and mature in different months of the year the laborers who finish the work at home go to other places where their help is needed.

Reports of the Bureau of Labor summarize the seasonal migration movement of agricultural laborers in the Philippine Islands as follows:

1. Ilocos provinces to the tobacco regions in the provinces of Cagayan and Isabela.

2. Ilocos provinces and La Union to the rice region of Central Luzon, consisting of the provinces of Pangasinan, Nueva Ecija, Tarlac, Bulacan, and to the sugar haciendas in Pampanga and Laguna.

3. Iloilo, Antique, and Cebu to the sugar districts of Occidental Negros.

4. Cebu, Bohol, and the subprovince of Siquijor to the abaca plantation of Mindanao.

5. Capiz to Mindoro; Batangas to Mindoro, Laguna, and Tayabas; and Pampanga to Mindoro.

Table 2 shows the possible sources of agricultural labor supply in the Philippine Islands.

Notwithstanding this natural movement of agricultural labor, farmers in isolated regions sustain heavy losses owing to delay in planting, harvesting or marketing because of lack of hands to help them. Here lies the real problem in our agricultural labor supply. An effective way of moving this labor supply to regions where it is needed should prevent these losses, consequently adding to our production. Living conditions and wages in our rural communities should be improved so as to attract laborers to stay, thus stabilizing the supply of farm hands.

Immigration

Statistics show that we have in the Philippine Islands an adequate supply of agricultural laborers. We, therefore, have no need of considering immigration as a source of our agricultural labor supply, at least for the present and probably for many years to come.

TABLE 2

Showing possible sources and supply of labor [a]

PROVINCES	TOTAL POPULATION	LABORERS		
		Total number	Percentage procurable	Number available
Abra	82,616	19,919	15	2,988
Antique	164,367	22,884	10	2,288
Bataan	63,811	13,270	10	1,327
Batanes	8,214	4,484	12	538
Batangas	379,266	91,638	10	9,164
Bohol	400,622	95,283	12	11,434
Camarines Norte	57,465	6,805	5	340
Capiz	322,006	74,123	15	11,118
Cavite	168,048	33,050	12	3,966
Cebu	950,435	248,434	15	37,265
Ilocos Norte	238,140	83,525	12	10,023
Ilocos Sur	231,614	87,341	12	10,481
Iloilo	546,828	120,838	12	14,501
Laguna	217,780	48,801	5	2,440
La Union	171,367	63,646	12	7,638
Leyte	696,963	136,832	15	20,525
Marinduque	59,328	7,840	5	392
Mountain Province	313,405	40,930	15	6,140
Nueva Ecija	271,125	80,329	12	9,639
Oriental Negros	306,170	68,330	15	10,250
Pangasinan	628,506	176,178	12	21,141
Rizal	267,834	17,778	5	889
Samar	433,261	113,797	15	17,070
Sorsogon	205,899	50,635	12	6,076
Sulu	211,707	10,000	12	1,200
Tarlac	189,293	29,091	10	2,909
Total	7,586,070	1,745,781		221,742

[a] From the Philippine Bureau of Labor Bulletin 26: 30. Issued March, 1927.

CONDITIONS AFFECTING OUR FARM LABOR SUPPLY

Emigration to Hawaii

The yearly exodus of thousands of Filipino agricultural laborers to Hawaii is a serious menace to the stability of our farm labor supply. Director Cruz of the Bureau of Labor reports that the Hawaiian Sugar Planters' Association has practically ceased importing foreign labor except from the Philippines. This report has partially caused the continuous outflow of Filipino laborers every year to Hawaii, a condition which has increased the number of Filipino laborers in that territory so largely that recent reports of Mr. Butler, the Secretary of the Hawaiian Sugar Planters' Association, state that about 25 per cent of the more than 40,000 Filipino laborers in

Hawaii do not have employment. The *Manila Daily Bulletin* of September 10, 1928, reported that many of the 600 Filipino laborers who left the Philippines for Hawaii in the early part of August, 1928, did not have work.

This exodus of Filipino laborers to Hawaii started in 1906. Eala (1927) reports that since that year to and including 1925, 74,896 Filipinos had emigrated to Hawaii. Those who returned during the same period numbered 15,519, leaving a difference of 59,377 who were supposed to be in Hawaii. Actually, there are 39,342 working men in Hawaii and approximately 2,890 women, making a total of 42,232. The majority of the laborers who go to Hawaii are Ilocanos, the others are from the Visayas, Cagayan, and Pangasinan.

The following tables show the movement of Filipino laborers to Hawaii and the United States:

TABLE 3

Showing Filipino emigrants to Hawaii, annually, from 1907 to 1925

YEAR	TOTAL	MALE	FEMALE	MINORS
1907	230	188	20	12
1909–14	19,039	unclassified		
1915	2,150	1,777	180	193
1916	2,214	1,877	157	180
1917	2,598	2,191	178	229
1918	2,761	2,030	284	447
1919	3,804	3,188	319	297
1920	3,454	3,042	225	187
1921	6,814	5,748	628	438
1922	8,183	7,291	530	362
1923	7,261	4,520	1,797	944
1924	9,869	8,171	1,116	582
1925	6,519	6,104	256	159
Total	74,896	46,127	5,690	4,030

TABLE 4

Showing returning Filipino emigrants to the Philippine Islands from 1907 to 1925

YEAR	TOTAL	MALE	FEMALE	MINORS
1907	2	——	——	——
1909–14	159	unclassified		
1915	347	260	40	47
1916	465	342	64	59
1917	733	568	72	93
1918	841	645	65	131
1919	948	677	104	167
1920	1,281	1,093	75	113
1921	2,705	1,953	249	503
1922	1,593	1,309	81	203
1923	1,496	1,226	112	158
1924	2,195	1,730	204	261
1925	2,754	2,183	264	307
Total	15.519	11.986	1,330	2,042

TABLE 5

Showing the number of Filipino laborers remaining in Hawaii after the expiration of their contract with the Hawaiian Sugar Planters' Association

YEAR	WENT TO HAWAII	RETURNED TO P. I.	REMAINED IN HAWAII	PERCENTAGE OF THOSE REMAINING TO TOTAL
1907	230	2	228	99.13
1909–14	19,039	159	18,880	99.16
1915	2,150	347	1,803	83.86
1916	2,214	465	1,749	79.00
1917	2,598	733	1,865	71.79
1918	2,761	841	1,920	69.54
1919	3,804	948	2,856	75.08
1920	3,454	1,281	2,173	62.91
1921	6,814	2,705	4,109	60.30
1922	8,183	1,593	6,590	80.53
1923	7,261	1,496	5,765	72.61
1924	9,869	2,195	7,674	77.76
1925	6,519	2,754	3,765	57.75
Averages	4,161	862	3.298	76.11

(NOTE:—Tables 3, 4, and 5 were taken from the Bulletin of the Bureau of Labor, 26: 18-19. Issued March, 1927.

It is obvious from reasons given by Robb (1927) and Eala (1927) that the Filipino laborers emigrate primarily for economic reasons. The social causes mentioned are insignificant and temporary and can not be taken as sufficient reasons for a laborer to leave his home. The Filipino laborers who leave their country to go to Hawaii have a strong desire to better their circumstances, to improve their living conditions. In Hawaii, planters pay higher wages than can be obtained in the Philippines; provide many privileges as comfortable houses, free medical and hospital attendance, schools, fuel, water, land for gardens, also conveniences for deposit of savings. This treatment is not offered in the Philippine Islands, hence, it is but natural for our farm laborers to emigrate to that territory where opportunities for a better standard of living and for accumulation of capital await them.

This continuous outflow of Filipino laborers to Hawaii "constitutes a great subtraction from the productive energy of the country". Owing to lack of farm hands to help them during their rush seasons, Philippine sugar planters made a move, six years ago, to secure the passing of a bill in the Legislature lifting the ban on Asiatic immigration. This move was not based on an understanding of the real condition of our farm labor supply. These planters learned that there are enough farm workers in the Philippines, but there is no organized means of moving them to regions where they are wanted. Also that the wages and conditions of living offered on the sugar plantations are no inducement for labor to go to them. Our planters, not only of sugar but of other crops, will have to meet all the demands of labor today as to wages and living conditions, or in other words compete with what other countries offer, if our emigration is lessened.

Differences in wages

Labor, like all other commodities, is governed by the law of supply and demand. The greater the demand for labor the higher the wages paid to laborers provided the supply remains constant, and vice versa. Laborers tend to move to places where wages are higher than those offered them at home. The difference in wages offered to agricultural laborers in the different rural communities in the Philippine Islands has something to do with the uneven distribution of our agricultural labor supply.

Table 6 shows the relative wages, by provinces, of unskilled agricultural laborers in the Philippine Islands.

The table shows that the average daily wages of unskilled agricultural laborers in the most densely populated provinces, such as Cebu, La Union, Ilocos Norte, Ilocos Sur, Capiz, and Iloilo are very much lower than those offered in the sparsely settled provinces of Cagayan, Davao, and Isabela. There is considerable surplus labor in the thickly populated provinces, hence, wages are lower than in the sparsely settled regions where the labor supply is less than the demand.

TABLE 6

Relative rates of wages of unskilled agricultural laborers by provinces in the Philippine Islands. 1925

PROVINCES	AVERAGE DAILY WAGES			
	Adults		Minors	
	Male	Female	Male	Female
	₱	₱	₱	₱
Abra	0.55	0.35	0.30	0.22
Agusan	0.70	0.48	0.47	0.35
Albay	0.67	0.30	0.34	0.22
Bataan	1.12	0.61	0.58	0.50
Batanes	0.57	0.25	0.31	0.20
Batangas	0.92	0.56	0.54	0.38
Bohol	0.60	0.35	0.33	0.23
Bukidnon	0.59	0.50	0.30	——
Bulacan	1.13	0.73	0.60	0.49
Cagayan	0.77	0.58	0.47	0.39
Camarines Norte	1.01	0.45	0.40	0.35
Camarines Sur	0.80	0.37	0.38	0.24
Capiz	0.54	0.33	0.29	0.23
Cavite	1.00	0.74	0.65	0.57
Cebu	0.45	0.32	0.28	0.22
Cotabato	1.85	0.65	0.40	0.40
Davao	1.04	0.68	0.57	0.44
Ilocos Norte	0.80	0.47	0.32	0.32
Ilocos Sur	0.66	0.41	0.37	0.28
Iloilo	0.61	0.41	0.38	0.29
Isabela	1.04	0.62	0.60	0.45
Laguna	1.19	0.78	0.69	0.52
Lanao	0.80	0.35	0.55	0.35
La Union	0.85	0.42	0.50	0.34
Leyte	0.66	0.38	0.36	0.24
Marinduque	1.15	0.55	0.70	0.36
Mindoro	0.86	0.60	0.48	0.40
Misamis	0.69	0.47	0.46	0.32
Mountain Province	0.48	0.40	0.33	0.29
Nueva Ecija	0.82	0.58	0.48	0.42
Nueva Vizcaya	0.91	0.56	0.38	0.36
Occidental Negros	0.78	0.51	0.46	0.35
Oriental Negros	0.57	0.39	0.32	0.24
Palawan	0.78	0.54	0.40	0.30
Pampanga	1.02	0.74	0.67	0.53
Pangasinan	0.77	0.53	0.48	0.40
Rizal	0.97	0.77	0.68	0.64
Romblon	0.67	0.33	0.33	0.23
Samar	0.65	0.38	0.35	0.25
Sorsogon	0.80	0.36	0.40	0.25
Sulu	0.40	0.30	——	——
Surigao	0.79	0.52	0.48	0.35
Tarlac	0.83	0.54	0.54	0.39
Tayabas	1.08	0.84	0.74	0.41
Zambales	0.85	0.56	0.50	0.35
Zamboanga	1.06	0.36	0.31	0.25
Average	0.82	0.49	0.45	0.35

It is, however, interesting to note that Occidental Negros, the province which often complains of insufficiency of laborers, offers an average daily wage of only 78 centavos, while in La Union, a densely populated province, it is 85 centavos. Regions, then, that suffer from shortage of farm hands should raise the wage offered high enough to induce laborers to come there. Otherwise these regions can not hope to secure a satisfactory supply of laborers.

The village system of settlement

Miller (1920) states that the village system of settlement by the Filipinos dates back to the coming of the Malayan peoples to the Archipelago. This system was encouraged by the Spaniards because it facilitated their work in Christianizing the natives and made it easy to govern them. Today, the uneven distribution of the population of the Archipelago is largely a result of this system of settlement. When a group of families settle in a place they stick to that settlement even if it becomes so crowded that scarcely enough food can be raised from the area to supply the community. Younger members of these families move away only when conditions following over-population compel them to.

The geographical situation of the country

The peculiar geographical situation of the Archipelago is another cause for the unequal distribution of our farm labor supply. Some islands are crowded because they were settled early while others are still sparsely settled or uninhabited. In order to make easy the migration of people from one island to another, the interisland steamship service throughout the Archipelago should be made more efficient. The rates should be low enough to permit migratory laborers to move to places where they are greatly needed.

Absence of good roads

The lack of good roads often isolates certain agricultural regions from the rest of the country. This makes the moving of labor supply to these regions difficult, resulting in their remaining in a backward condition.

School term coincides with working season

The long vacation of all pupils in schools throughout the Philippine Islands falls during March, April, and May, the months when there is practically nothing to be done on the farm. Without giving thought to the question, our young people have been criticized for doing nothing at home during vacation. The young people are not to blame for their idleness. When they go home they find their parents doing nothing, for it is the idle season on the farm. To correct this situation, our educational authorities should take this idle season into consideration and change the school term schedule. The long vacation should coincide with the principal planting season of food crops, such as rice, etc.; then the students would be able to

assist their parents. With this plan, students could be of service not only with their work but by introduction of the principles they learn in farm and other schools in the work on their parents' farms. This would hasten the adoption of new methods in agriculture by our conservative farmers.

These are some of the conditions affecting the distribution of our farm labor supply. What have our farmers done to improve these conditions? Has our Government given the farmers any help towards bettering farm labor conditions?

ATTEMPTS TO SOLVE OUR FARM LABOR PROBLEM

Discourage emigration to Hawaii

The Bureau of Labor has been trying to lessen the number of Filipino laborers going to Hawaii. Recently, the Director of this bureau required all labor agents to file bonds with the Government before they could recruit laborers. Very strict regulations are also being enforced upon the laborers who wish to go to Hawaii. For example, the boats chartered to carry laborers to that territory are required to meet certain regulations imposed upon them by the Bureau of Customs; medical examination of all laborers is also required before they can sail.

Despite these efforts of the Government to discourage emigration, there has been in increasing numbers a continuous outflow of Filipino agricultural laborers to Hawaii. During the first week of August, 1928, there were 955 Ilocano laborers who sailed on two steamers bound for Hawaii.

As it is impossible to legally prevent these people from going abroad without curtailing their freedom, the only way to diminish the number is to attract them to stay on our plantations or induce them to settle upon our public domain. This might be done in two ways; namely, (1) by offering as high wages comparatively as is offered in the Hawaiian plantations and by giving the laborers similar comforts, privileges, and amusements; and (2) by preaching to these laborers that it is not to their advantage to go abroad. The first is self-explanatory. The second can be effectively carried out by giving more power to the Bureau of Labor so that it can stop unauthorized labor agents encouraging laborers to go abroad at their own expense. Only laborers who have been contracted to work on the Hawaiian sugar plantations by the Hawaiian Sugar Planters' Association should be allowed to emigrate. Those who wish to go to that territory at their own expense and who go there to speculate on getting a job should not be permitted to sail unless they are assured by the Labor Commissioner in Hawaii that there is work waiting for them. Agents of the Bureau of Labor should be sent to the provinces from where most of these emigrants come to tell the people about the advantages of staying at home and helping in the development of our own natural resources.

The Government is making some effort to induce labor to stay in the Philippines by offering free transportation to settlers from their homes to

places where they can make settlements through Government aid. The Government also induces laborers to settle in colonies that are established for the purpose of increasing the agricultural production of the country. Such colonies are located in isolated and unoccupied regions in the country. Laborers are given free transportation, free holdings, and advances in the form of money, implements, and work animals, provided they stay and work on the land settlements assigned to them. These plans by the Government tend to equalize the distribution of the population of the country but affect only a relatively small number.

Increase wages and offer continuous work

During one of the annual conventions of the Philippine Sugar Association some one suggested that lowering of wages is one way of reducing the cost of sugar production in the Islands. Theoretically, this is true, but sound economics does not warrant its application. It is claimed that our laborers are very poor workmen compared with the laborers in Hawaii and Cuba. This inefficiency is largely due to lack of good food, proper shelter, often lack of medical attention—these things give men extra energy in working. Our laborers can not afford to buy good food because their wages will supply only food enough to keep them alive. Laborers in Hawaii and Cuba are paid more in actual cash besides the comforts provided, hence, their standard of living is higher, and they can do more work.

If we wish to increase the efficiency of our laborers, we should make a higher standard of living possible. They should be paid wages high enough to enable them to buy sufficient good food that they may have the strength to do hard work. Furthermore, increasing the wages of our laborers will tend to reduce the cost of production per unit of labor in the industry where they are employed.

Another thing that makes farm labor supply a problem in some of our agricultural regions is the lack of continuity of employment owing to lack of work during certain seasons of the year. Laborers are employed only during the planting and harvesting seasons. Between these seasons they are discharged because their employers have no work for them. Consequently, these laborers have to move to other places where they can find work during these idle seasons. Now, the uncertainty of weather conditions and the lack of transportation facilities make uncertain the coming back of these laborers to the same place. This situation often causes shortage of labor in some regions. This, in turn, results in decreased production.

Our planters, especially the sugar planters, should endeavor to furnish their laborers with continuous work throughout the year. This can be done either by practicing diversified farming as is being done on the Canlubang Sugar Estate where there are coconut and coffee plantations in addition to the sugar plantations, or by continuous cropping as is practiced

in Cuba where sugar crops stay on the plantations for as long as twenty years.

The offering of continuous work, however, is desirable only in regions where laborers are paid in cash or are employed by contract. In places where they are paid by a percentage of the produce, as is the practice in the rice regions where laborers get from 10 to 25 per cent of the crop depending on the supply of labor, laborers can not be prevailed upon to stay after the harvest season. They go back to their homes because they migrated to the rice region only after their farm work at home had been finished.

Improvement of roads

In the large islands, as Luzon, there are isolated places which often experience heavy losses in agricultural products because of lack of farm hands. These places would not have any difficulty in securing a labor supply if they were connected with the densely populated regions by good roads. The San José-Santa Fe road illustrates the possible effect of roads on labor supply. Before it was built people from the thickly populated Central Plain of Luzon and from the Ilocos provinces could go to the sparsely settled Cagayan Valley only with difficulty. People of the Valley could raise only tobacco and corn in rotation. They imported rice from Pangasinan and Nueva Ecija through the seaport, Aparri. Now, throughout the Valley people are beginning to plant rice. They can do this because migratory laborers can reach that region by truck or automobile over the San José-Santa Fe road.

As the migration of our laborers is seasonal and as our labor supply on the farm depends to a large extent on this class of agricultural laborers, good roads should be built as fast as possible connecting all isolated regions with the densely populated districts that have a labor supply.

SUMMARY

There are 2,547,572 agricultural laborers in the Philippine Islands, or less than one laborer for every hectare of the 3,703,700 hectares under cultivation. In addition to this number we have about 600,000 migratory agricultural laborers, a number sufficient to meet the demand of our farmers.

Our agricultural labor supply is largely dependent upon the migratory laborers, but conditions peculiar to the country often cause shortage of farm hands in certain regions. These conditions are:

1. The emigration of Filipino laborers to Hawaii which has been going on continuously since 1906 is a serious menace to the stability of our farm labor supply. This continuous outflow of Filipino farm hands from the Islands could be stopped by: (a) offering to these laborers as high wages, comparatively, and providing them with conveniences, such as free housing, free fuel, free water, free medical treatment, facilities for saving, etc., as is offered them by the Hawaiian planters; and (b) encouraging them

to settle upon the vast unoccupied public domain; that is, induce them to take up homesteads or settle in the Government colonies already established in certain parts of the country. This latter scheme tends to equalize the distribution of our population, thereby eventually helping to stabilize our farm labor supply.

2. The low wages offered laborers in certain agricultural regions, such as in the Negros sugar plantations, do not attract migratory laborers from the densely populated provinces to go there for work. Wages in such regions where the labor supply is insufficient to meet the demand of the farmers should be made high enough to attract migratory laborers, thus preventing the recurrence of losses because of lack of farm hands.

3. The gregariousness of the Filipino people explains why the labor supply is plentiful in certain regions in the country while it is scarce in others. Some parts of the Islands are very densely populated while other parts are unoccupied or sparsely peopled. This habit could be eliminated in time. As the people advance in civilization they become more and more ambitious and their views are broadened thus making them see the disadvantages of living in crowded settlements which yield hardly enough for their support.

4. The peculiar geographical situation of the Archipelago makes it hard for migratory laborers to reach certain regions, thus causing shortage of farm hands in places. Cheap and efficient inter-island steamship service would relieve this situation.

5. The present system of having the schools open throughout the country during the busy seasons on the farms, that is planting and harvesting seasons, draws off of the farms many boys and girls who might be of great help to their parents. The vacation of all schools in the country should coincide with the planting or harvesting season of crops, such as rice, sugar, etc., so that the boys and girls in schools could help their parents. This would add to the labor supply in the agricultural regions.

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A FUSARIUM CAUSING BULB ROT OF ONION IN THE PHILIPPINES[1]

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WITH FOUR PLATES AND FOUR TEXT FIGURES

INTRODUCTION

On December 28, 1926, a bundle of diseased onions was brought to the attention of the writer. The onions came from Lemery, Batangas Province. The plants showed yellowing and dying-back of the leaves. The bulbs were soft and showed a semi-watery decay. Microscopic examination of tissues from the margin of the infected portion revealed an abundance of fungous hyphae. Conidia were found in the slimy mass of rotted tissues. They were either septate or non-septate and were typical of those of *Fusarium*. The causal fungus was isolated by the writer and first proved pathogenic on Singapore Red onion.

THE DISEASE

History and geographical distribution

According to Walker and Tims (1924) reports of the *Fusarium* bulb rot of onion were made from Ohio in 1910 by Selby, from Japan in 1914 by Hanzawa, and from Connecticut in 1915 by Clinton. Walker and Tims (1924) found that the bulb-rot of onion occurs in the northern Mississippi Valley and identified its causal agent with *Fusarium cepae* Hanzawa. According to Link and Bailey (1926) the fungus described by Walker and Tims as *F. cepae* Hanzawa emend. Walker and Tims is *F. zonatum* forma 1 (Sherb.) Wr. Link and Bailey (1926) report several species of *Fusarium* as occurring in the rotting bulbs of onions which they obtained from the fields, markets, and storage of practically all the large onion-growing sections in the United States and from Egypt and Spain. These authors report that *F. cepae* Hanzawa and *F. zonatum* (Sherb.) Wr. are always pathogenic, *F. bulbigenum* Cke. and Mass. and *F. moniliforme* not consistently pathogenic, and *F. oxysporum* (Schlecht.) Wr. and *F. vasinfectum* Atk. not patho-

[1] Experiment Station contribution No. 552.

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[2] The writer is indebted to Dr. G. O. Ocfemia of the Department of Plant Pathology for some valuable suggestions during the course of this investigation and in the preparation of the manuscript.

genic. The other species of *Fusarium* that they isolated from the decayed onion bulbs did not prove pathogenic. They further found that most of the pathogenic species of onion bulb rot *Fusarium* belong to section Elegans.

Thus far the bulb rot of onion is known to occur only in the United States and Japan and probably in Egypt and Spain where Link and Bailey (1926) obtained some of their materials, and in the Philippines.

Economic importance

According to Walker and Tims (1924) the *Fusarium* bulb rot of onion is one of the most serious diseases in certain onion fields in the United States. The enormity of loss in the field, in storage, and in transit warrants a careful study of the disease and its control measures.

Link and Bailey (1926) noted serious field losses caused by bulb rot in the onion fields in Colorado in 1920. They also found that bulb rot was a serious menace in the onion shipments from Texas in 1922 and was an increasingly serious factor in the production and marketing of onions at Walla Walla, Washington.

There has been no report published on the *Fusarium* bulb rot of onion in the Philippines. But in 1925 the attention of Professor Raymundo of the Agronomy Department in this College, was attracted by the serious damage caused by this disease in an onion field in the Experiment Station. He estimated the loss to be about 40 to 50 per cent of the crop. The writer found that the loss in an onion field attacked by rots caused by *Fusarium* and *Sclerotium* in Lemery, Batangas, was from 40 to 60 per cent. Onions in Batangas are planted in November or a few weeks after the close of the rainy season. The writer was informed by some onion growers in Lemery that the rotting of onion bulbs which they call *pasik* occurs in many fields every year, especially if the soil is dampened by occasional December and January showers. Presumably, these growers plant either infected bulbs or healthy ones in a "Fusarium-sick soil."

Symptoms

The characteristic symptoms of the disease are the yellowing and dying-back of the leaves starting from the tips. Complete yellowing and subsequent drying out of leaves take place in five to ten days, depending upon the length and size of leaves and severity of infection.

Before the symptoms are shown on the aërial parts of the plants, rotting has started either in the bulb, true stem, or root system. General rotting of the onion bulb starts from the true stem. White moldy growth is often found on the rotted scales.

In an advanced stage of infection the bulbs show a semi-watery decay. The surface of the rotting scales is slimy to the touch. The mycelium of the causal fungus is present in the affected part of the bulb. Maggots[3], bacteria,

[3] According to Mr. S. M. Cendaña of the Department of Entomology, College of Agriculture, the maggots are larvae of certain flies.

and nematodes are oftentimes found in the decayed tissues. The writer believes that the broken-down tissues of onion bulbs caused by *Fusarium* make a good substratum for the growth and multiplication of bacteria, nematodes, and other soil organisms in the field. These organisms cause rapid rotting of broken-down tissues.

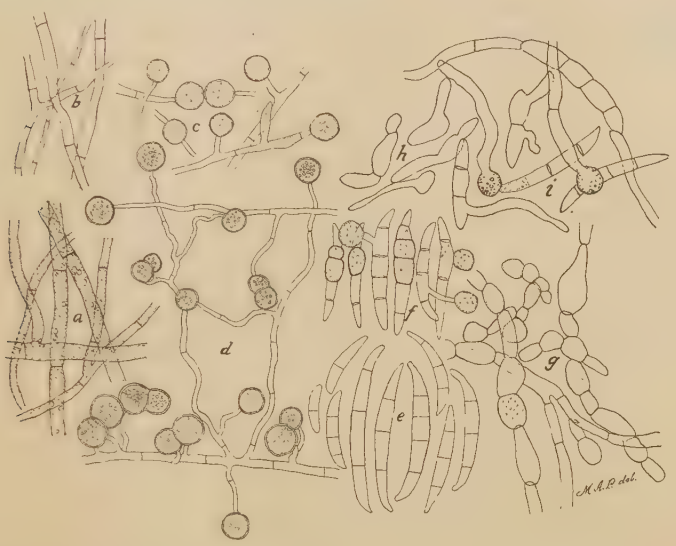

Fig. 1.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (*a*) Mycelium from a 48-hour culture on potato-dextrose agar. ×560. (*b*) Mycelium from a 6-month old culture on potato-dextrose agar. ×560. (*c*) Hyphal chlamydospores from a porodochium of 1½-month old culture on hard oatmeal agar. ×430. (*d*) Hyphal chlamydospores from pionnotes of a 14-day old culture on corn meal agar. ×430. (*e*) Septate conidia from sporododhium of a 1½-month old culture on hard oatmeal agar. ×420. (*f*) Different forms of conidial chlamydospores from sporodochium of a 1½-month old culture on hard oatmeal agar. ×430. (*g*) Sclerotium like cells from a 3-month old culture on beef extract agar. ×430. (*h*) Germinating conidia. ×1120. (*i*) Germinating conidial chlamydospores. ×560.

CAUSAL ORGANISM

Method of isolation and preparation of subcultures

The bulb which showed an early stage of infection was soaked in 1:1000 mercuric chloride solution for two minutes. The solution was then washed off with sterile water. The outer scale was taken off and the innermost infected parts were cut with a flamed scalpel and plated out on sterile potato-dextrose agar. Transfers were made on slants of hard oatmeal agar from the pure colonies. The cultures on the different media were made by diluting the spores from the sporodochium in water and then inoculating each culture tube with a loopful of the spore-suspension.

Morphology

Mycelium. The mycelium of a young culture appears as fine, white threads. It is granular and vacuolate as shown in figure 1*a*. The branches are laid at wide intervals often above 200 μ. The hyphal cells are short. A great majority of the hyphal cells are below 20 μ in length. They vary from 7 μ to 35 μ in length and from less than 2 μ to 4.6 μ in width. The hyphae of an old culture are less granular as shown in figure 1*b*. Many of them appear to be empty.

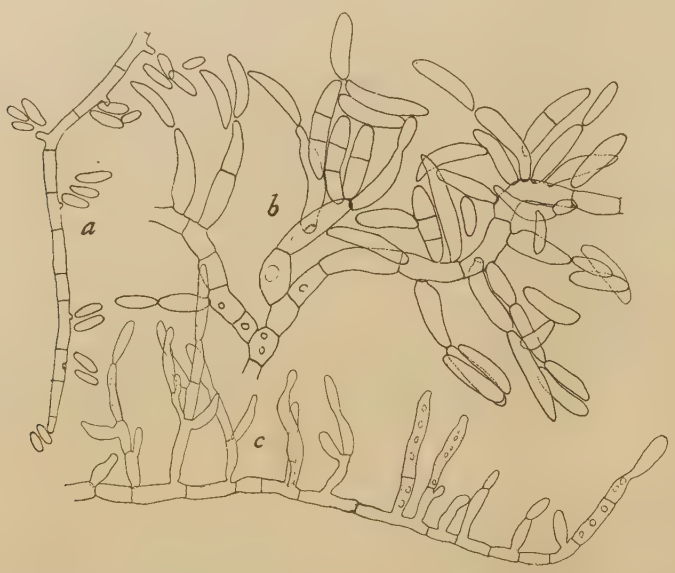

Fig. 2.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (*a*) Conidiophores originate as small projections on the side of the hyphal filament and bear usually 0-sepate conidia. ×430. (*b*) Conidiophores bearing large and septate conidia. ×560. (*a*) and (*b*) from a 26-hour-old hanging-drop preparation in potato-dextrose agar. (*c*) A hyphal thread from a 3-dav-old culture on soybean-dextrose agar showing the formation of long branched conidiophores. ×430.

Conidiophores. The conidiophore and conidium-formation were studied from a hanging drop preparation in potato-dextrose agar. The conidiophores develop within 15 hours in culture. They are produced by the aërial hyphae or in the pionnotes. They appear as short lateral branches of the mycelium. They are granular and vacuolate while young and are constricted at the points of origin.

There were three or more types of conidiophores observed in hanging drop preparation. The first of these types are those which appear as small lateral protrusions of the hyphae. They generally bear the non-septate conidia (fig. 2*a*). It was also observed that those minute projections produce both the septate and nonseptate conidia (fig. 3c) and in a few cases only large and septate conidia (fig. 3*b*) are borne by them.

Club-shaped conidiophores arise singly or in groups from the hyphal cells. They are constricted at the points of origin, slightly enlarged at the middle and then taper gradually toward the rounded ends. They measure from 8 to 10 μ in length and from 3 to 5 μ at the widest diameter. Some of these club-like conidiophores are divided into segments and they generally bear the large and septate conidia.

Branched and dendroidal conidiophores have been observed oftentimes from the pionnotes. The branches arise singly or in groups below each septum (fig. 2*c*.) The dendroidal conidiophores (fig. 3*a*) bear generally the large and septate conidia. The conidiophores appear to be less granular and empty after they have produced numerous conidia.

Conidia. The conidia may be found in even less than a 24-hour-old culture. An initial conidium appears as a small swelling above a constriction at the end of the conidiophores. This incipient conidium grows out rapidly in length but slowly in width. When it has reached its characteristic shape and size, a septum is laid out at the constriction. The mature conidium is detached and pushed either upward or aside as soon as another conidium is produced on the same conidiophore. The writer had occasion to observe two conidiophores producing the septate conidia at an average rate of one in about an hour until three were formed. The rate of conidium-formation varies from less than an hour to more than two hours. Septation of the conidia takes place several hours after their detachment from the conidiophores. In some culture media it takes place after a few days.

The spores vary in shape, size, and septation. The septa vary from zero to eight. Conidia with as many as six to eight septa were rarely noted. The 0-septate conidia are as abundant as the septate conidia on a few agar media. Mostly septate conidia are found in the rotting tissues of onion bulb.

The septate conidia are generally sickle-shaped, apically attenuate, apedicillate to slightly pedicillate (fig. 1*e*). Some are, however, nearly straight. The septa are typically three and rarely more or less than this number. They are granular while young but with age they gradually lose this character.

The 0-septate conidia are generally ellipsoidal. A few 1– to 2-septate conidia have also this shape.

The measurements[4] of spores on different media are as follows:

On oatmeal agar with 2 per cent dextrose, 17 days old
4–septate, 28 to 32 by 4.0 μ (3)[5], 30 by 4 μ average
3–septate, 20 to 36 by 2.4 to 4.8 μ (35), 27.7 by 3.8 μ average
2–septate, 18 to 28 by 2.4 to 4.0 μ (9), 21.8 by 3.1 μ average
1–septate, 14 to 24 by 2.0 to 3.6 μ (4), 16.4 by 2.7 μ average
0–septate, 4 to 14 by 1.2 to 3.6 μ (50), 7.3 by 2.0 μ average

[4] Only spores obtained from pionnotes were measured. No effort was made to determine the relative abundance of spores of different septation on the different media.

[5] Numbers in parentheses indicate number of spores measured.

On oatmeal agar without dextrose, 14 days old
4–septate, 31.2 by 4.4 μ (1)
3–septate, 24.0 to 44.8 by 3.6 to 4.8 μ (22), 34.3 by 4.1 μ average
2–septate, very rare if any
1–septate, 10 to 24 by 2.4 to 4.4 μ (5), 15.6 by 3.4 μ average
0–septate, 4 to 14 by 2.0 to 4.0 μ (47), 9.1 by 3.1 μ average

On corn meal agar with 2 per cent dextrose, 28 days old
4–septate, 38 to 40 by 4 to 4.4 μ (3), 37.3 by 4.1 μ average
3–septate, 20 to 44 by 3.2 to 4.4 μ (34), 32.2 by 3.9 μ average
2–septate, 20 to 30 by 3.2 μ (2), 25 by 3.2 μ average
1–septate, 11.2 to 22 by 2.8 to 3.2 μ (12), 18.2 by 3 μ average
0–septate, 4 to 10 by 1.6 to 4 μ (50), 7.4 by 2.9 μ average

On corn meal agar without dextrose, 28 days old
5–septate, 42 by 4.4 μ (1)
4–septate, 40 to 48 by 4.4 to 4.8 μ (3), 44 by 4.4 μ average
3–septate, 18 to 46 by 3.2 to 4.8 μ (34), 35.9 by 4.4 μ average
2–septate, 18 to 20 by 3.2 μ (3), 18.6 by 3.2 μ average
1–septate, 12 to 20 by 2.8 to 3.2 μ (8), 17 by 3.1 μ average
0–septate, 4 to 12.8 by 2 to 3.2 μ (17), 8.4 by 2.6 μ average

On onion decoction agar with 2 per cent dextrose, 25 days old
4–septate, 36 to 44 by 4 to 4.4 μ (4), 38.5 by 4.3 μ average
3–septate, 20 to 46.8 by 3.2 to 4.8 μ (34), 34.9 by 4.1 μ average
2–septate, 16 to 26 by 2.8 to 4 μ (9), 21.8 by 3.5 μ average
1–septate, 16 to 28 by 3.6 to 4 μ (3), 20.6 by 3.7 μ average
0–septate, 4 to 12 by 1.6 to 4.4 μ (50), 7.4 by 2.9 μ average

On onion decoction agar without dextrose, 28 days old
5–septate, 44 by 4.4 μ (1)
4–septate, 43.2 to 48 by 4 to 4.8 μ (7), 45.3 by 4.1 μ average
3–septate, 18 to 44.8 by 3.2 to 4.4 μ (25), 35.2 by 3.9 μ average
2–septate, 16 to 32 by 3.2 to 4.4 μ (10), 19.9 by 3.7 μ average
1–septate, 7.2 to 20 by 2.4 to 4.4 μ (13), 13.3 by 3.3 μ average
0–septate, 4 to 10 by 1.6 to 4.4 μ (49), 6.2 by 2.6 μ average

On soybean agar with 2 per cent dextrose, 1 month old
5–septate, 36 to 40 by 4 to 4.4 μ (2), 38 by 4.2 μ average
4–septate, 36 to 40 by 4 to 4.8 μ (3), 37.3 by 4.5 μ average
3–septate, 22 to 40 by 3.2 to 4.8 μ (36), 29.9 by 3.9 μ average
2–septate, 16 to 22 by 3.2 to 3.6 μ (5), 18.9 by 3.3 μ average
1–septate, 15.2 to 18 by 3.2 μ (4), 17.1 by 3.2 μ average
0–septate, 4 to 12 by 1.6 to 4 μ (50), 7.2 by 2.8 μ average

On soybean agar without dextrose, 21 days old
4–septate, 32 to 40 by 4 to 4.4 μ (5), 36 by 4.3 μ average
3–septate, 22 to 40 by 3.2 to 4.8 μ (93), 32.8 by 4.1 μ average
2–septate, 20 by 3.6 μ (1)
1–septate, 18 to 20 by 3.2 to 3.6 μ (2), 18.8 by 3.4 μ average
0–septate, 4 to 10 by 1.6 to 4.8 μ (50), 6.8 by 2.7 μ average

On beef extract agar with 2 per cent dextrose, 9 days old
4–septate, 32 to 44 by 2.8 to 4 μ (12), 38.4 by 3.4 μ average
3–septate, 18 to 48 by 2.4 to 4 μ (82), 30.4 by 3.4 μ average
2–septate, 16 to 20 by 2.4 to 3.6 μ (7), 18.8 by 3.1 μ average

1–septate, very rare
0–septate 4 to 12 by 1.6 to 4 μ (30), 9.7 by 2.6 μ average

On beef extract agar without dextrose, 7 days old
8–septate, 60 by 6.8 μ (1)
7–septate, 52 to 60 by 4.8 to 6.0 μ (2), 56 by 5.4 μ average
6–septate, 40 to 56 by 4.8 to 6.0 μ (7), 48.5 by 5 μ average
5–septate, 48 to 52 by 4.4 to 4.8 μ (2), 50 by 4.6 μ average
4–septate, 36 by 4.8 to 5.6 μ (2), 36 by 5.2 μ average
3–septate, 18 to 46 by 2.4 to 5.6 μ (80), 32 by 4.6 μ average
2–septate, 22 by 4.8 μ (1)
1–septate, 8 to 24 by 2.4 to 4.8 μ (12), 12.6 by 3.8 μ average
0–septate, 6 to 12 by 2 to 4.0 μ (50), 8.5 by 3.2 μ average

On potato-dextrose agar
5–septate, 44 to 52 by 4 to 4.4 μ (4), 49 by 4.3 μ average
4–septate, 44 to 48 by 4 to 4.4 μ (5), 46.4 by 4.1 μ average
3–septate, 18 to 38 by 3.2 to 4 μ (24), 32.4 by 3.9 μ average
2–septate, 15.2 to 16.8 by 3.2 μ (3), 16 by 3.2 μ average
1–septate, 8 to 18 by 2.4 to 4 μ (4), 10.8 by 3 μ average
0–septate, 4 to 8.8 by 2 to 3.2 μ (24), 5.7 by 2.6 μ average

On potato plugs, 1 month old
4–septate, 38 to 44 by 4 μ (4), 41 by 4 μ average
3–septate, 16 to 48.8 by 2.8 to 4.8 μ (40), 31.2 by 3.9 μ average
2–septate, 20 by 4 μ (1)
1–septate, 8 to 12 by 3.2 to 4 μ (6), 9.5 by 3.4 μ average
0–septate, 4.8 to 12 by 2 to 4 μ (42), 8.1 by 3 μ average

On corn meal, 1 month and 10 days old
4–septate, 36 by 4 μ (1)
3–septate, 16 to 39.2 by 3.2 to 4.8 μ (40), 30.7 by 4 μ average
2–septate, 15.2 to 20 by 2.4 to 4 μ (4), 22.4 by 3.6 μ average
1–septate, 16 by 4 μ (1)
0–septate, 4 to 10.4 by 1.6 to 3.6 μ (50), 7.6 by 2.6 μ average

The average measurements of the conidia on all media are as follows:
8–septate, 60 by 6.8 μ (1) (very rare)
7–septate, 52 to 60 by 4.8 to 6 μ (2), 56 by 5.4 μ average (very rare)
6–septate, 40 to 56 by 4.8 to 6 μ (7), 48.5 by 5 μ, average (very rare)
5–septate, 36 to 52 by 4 to 4.8 μ (10), 44.7 by 4.4 μ, average (very rare)
4–septate, 31.2 to 48 by 2.8 to 5.6 μ (43), 38.2 by 4.2 μ, average
3–septate, 16 to 48.8 by 2.4 to 5.6 μ (579), 32.3 by 4.0 μ, average
2–septate, 15.2 to 32 by 2.4 to 4.8 μ (55), 20.2 by 3.5 μ, average
1–septate, 7.2 to 28 by 2 to 4.8 μ (74), 15.5 by 3.3 μ, average
0–septate, 4 to 12 by 1.2 to 4.8 μ (559), 7.6 by 2.7 μ, average

The conidia were produced profusely on all media tested by the writer. The measurements of the spores given above seem to show that the presence of dextrose in the media does not stimulate the growth in size of the conidia. The conidia are in general larger on media without dextrose than those on media containing this sugar. But the growth of the fungus on media containing dextrose is a little faster and a little more luxuriant than on those without it as shown in table 1.

TABLE 1

Comparative amount of growth on different agar media with and without dextrose in plate cultures of the Philippine onion bulb rot Fusarium

MEDIA	WITH DEXTROSE	WITHOUT DEXTROSE
	Average diameter of growth	Average diameter of growth
	cm.	*cm.*
Beef extract agar	8.4	6.1
Corn meal agar	8.1	6.8
Oatmeal agar	8.0	7.6
Potato agar	7.0	5.5
Onion agar	5.4	4.5
Soybean agar	7.6	6.4

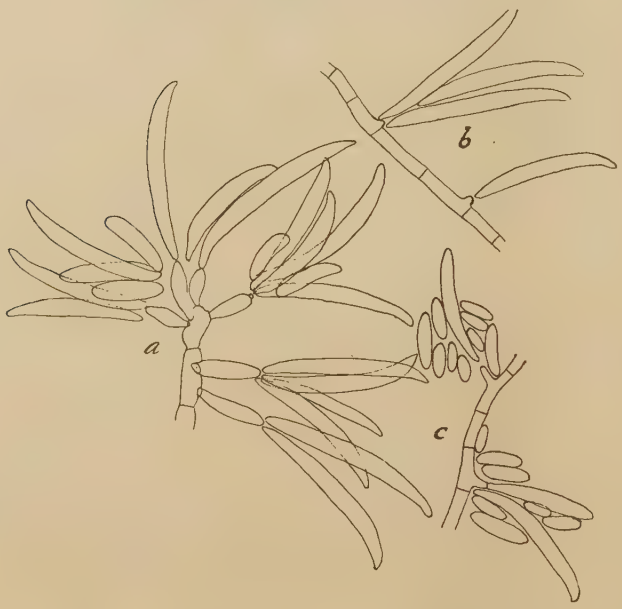

Fig. 3.—Camera-lucida drawing of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing conidiophores from a 47-hour-old hanging-drop preparation in potato-dextrose agar. (*a*) Dendroidal conidiophore bearing the young large septate conidia (septation was observed later). (*b*) Conidiophores shown by mere minute projections and bear the large septate conidia. (*c*) Small protrusion bearing both the 0-septate and septate conidia. All drawings are ×560.

Anastomosis of conidia was observed on some agar media. On hard oatmeal agar there were two to as many as seven conidia anastomose (fig. 4*a*). They were connected by hyaline tubes very often between end segments. The hyaline connections occurred also between an end segment of a conidium and a middle segment of another conidium.

A conidium germinates by the production of a germ tube or two germ tubes one at each end segment (fig. 1*h*) within eight hours. Before the conidium sends out its germ tube it swells a little and becomes constricted at the septa (fig. 4*b*). If the conidium bears a chlamydospore the germ tube arises from the chlamydospore and never from any other part of the conidium.

Chlamydospores. Hyphal and conidial chlamydospores were both produced. They are thick-walled, and granular. The writer believes that they are resting bodies of the onion-bulb rot *Fusarium.*

The hyphal chlamydospores are terminal and intercalary and are smooth and spherical (figs. 1*c* and *d*). They are produced both on aërial mycelium or in pionnotes in a culture tube of about 10 to 15 days old.

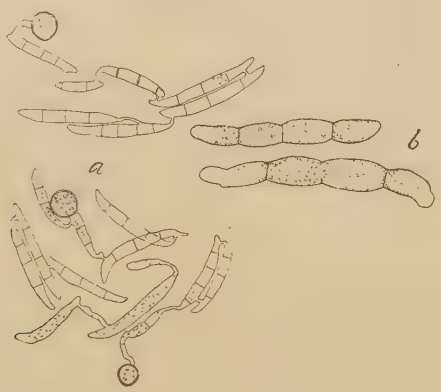

Fig. 4.—Camera-lucida drawings of *Fusarium zonatum* (Sherb.) Wr. forma 1 showing (a) Anastomosis of conidia from a 14-day-old culture on hard oatmeal agar. ×430. (b) Conidia in their first stage of germination. ×560.

They are unicellular to two-celled. Occasionally, they form chains of three to four or more cells. They vary from 6 μ to 10 μ in diameter and the average size of 275 bodies is 8 μ.

The conidial chlamydospores are produced when the culture is about a month old. They are either central, terminal, subterminal, sessile, or borne on a stalk that arises from one of the segments of the conidium (fig. 1*f*). Those that are produced in the middle segment are either ovoid, barrel-shaped or spherical Those that are terminal, subterminal, sessile, and those that are borne on stalks are, in general, spherical in shape. The conidial chlamydospores are seldom two- or three-celled. The measurements of 250 conidial chlamydospores of the ovoid and barrel-shaped types vary from 4 μ to 14 μ in length and from 3 μ to 8.4 μ in width. The average length falls between 7.8 μ and 8.0 μ and the average width is 5.2 μ. The conidial chlamydospores of the spherical type measure from 4 μ to 10.2 μ in diameter. The average diameter of 250 of this type was 6.5 μ.

Forms of fructification. Conidia are produced by the hyphae creeping on the surface of agar media or by the aërial threads. Macroscopically the aërial filaments appear as fine, powdered white threads when numerous conidia are produced by them. When myriads of these conidia have been produced by the mycelium the growth becomes compact. The conidia together with the fruiting branches form numerous minute, wart-like heaps of spores which appear slimy, especially in the presence of much moisture. They resemble the type of fructification which Sherbakoff (1915) calls *pseudopionnotes*. The bodies which resemble the pseudopionnotes of Sherbakoff merge together and converge into a continuous slimy mass of spores known as *pionnotes*. In a three-week-old culture on hard oatmeal agar where moisture is much less than in ordinary media the wart-like heaps of spores together with the conidiophores are large, elevated, and ochraceous salmon in color. These structures are similar to those termed *sporodochia* by Sherbakoff (1915).

Other characters of the Philippine onion bulb rot Fusarium. Certain abnormal characters of the mycelium were observed on some media In a 6-day old culture on onion-decoction agar exceptionally large and swollen vacuolate hyphae were noted. Barrel-shaped sclerotium-like cells (fig. 1*g*) were observed from the pionnotes of a 3-month-old culture on beef-extract agar but no true sclerotia was formed on this medium.

Cultural characters

The growth is profuse on beef-extract agar, oatmeal agar, potato agar, onion agar, corn meal agar, potato plugs, and corn meal. It is thin on corn meal agar. Aërial mycelium is typically scanty on all agar media and especially so on oatmeal agar and corn meal. The growth is at first whitish but with age it becomes pale pinkish buff to pinkish buff[6] on most media owing to the production of pionnotes on the surface of the slant. On beef-extract agar containing dextrose the pionnotes is shell pink to buff pink in young culture and avellaneous to wood brown in old culture. The surface of the slant becomes wrinkled. On corn meal the growth is cameo pink to Rosolane pink. On steamed rice the growth is fast and abundant but the color is variable. It ranges from pale ochraceous salmon or pale salmon color to salmon-buff. On agar media containing two per cent dextrose the growth is faster and the color is a little deeper than on those without this sugar. The growth in sterile plates is flat and three to six distinct zones may be observed on all agar media tested.

Taxonomy

After consulting the key to the sections of *Fusarium* given by Wollenweber, Sherbakoff, Reinking, Johann, and Bailey (1925) it is evident that

[6] The color of the culture was determined by comparing with Ridgway Color standards and color nomenclature (1912).

the Philippine onion bulb rot *Fusarium* belongs to the section Elegans. The shape and size of the 3-septate conidia[7] are close to *Fusarium cepae* Hanz. emend. *Fusarium zonatum* (Sherb.) Wr. forma 1 and *Fusarium zonatum* (Sherb.) Wr. forma 2 Link and Bailey. The presence of zones in agar plates is the essential difference between the fungus under investigation and *F. cepae*. The fungus under study agrees with forma 1 and forma 2 of *F. zonatum* as to curvature of macroconidia but differs slightly as to size of the 3-septate conidia and shape of the basal cells. The two forms produce macroconidia which are predominately 3-septate. According to Link and Bailey (1926) the measurements of the 3-septate conidia of *F. zonatum* forma 1 are 37.1 by 3.8 μ and *F. zonatum* forma 2 38.5 by 3.7 μ. The Philippine onion *Fusarium* are 32.3 by 4.0 μ. This fungus differs from any of the two forms mentioned above by being a little shorter and a little broader. But Link and Bailey (1926) have separate measurements for small 3-septate conidia, the average of which are not included in the figures given above. If the average measurements of the small 3-septate conidia would be included the discrepancy in length is probably accounted for. These rather close identities of the Philippine onion bulb rot *Fusarium* with any of Link and Bailey's forms, together with its zonate character in agar plates, cause the writer to believe that the Philippine fungus is also *F. zonatum*.

The Philippine *Fusarium* seems to lie more closely to *F. zonatum* (Sherb.) Wr. forma 1 than to *F. zonatum* (Sherb.) Wr. forma 2 Link and Bailey. It differs materially from *F. zonatum* forma 2 by the absence of red color on steamed rice. It differs from *F. zonatum* forma 1 only in shade of color on steamed rice. On steamed rice the Philippine fungus is pale ochraceous salmon or pale salmon color to salmon-buff and *F. zonatum* forma 1 is cream white to salmon buff or salmon color. This slight difference in shade of color if it be regarded as a difference at all is not sufficient evidence to segregate the Philippine *Fusarium* from *F. zonatum* (Sherb.) Wr. forma 1. In this paper the fungus in question is considered as a more virulent type of *F. zonatum* (Sherb.) Wr. forma 1 because it is capable of infecting onion bulbs without wounds.

Proof of pathogenicity

Pot inoculation. Healthy bulbs of Singapore Red, Singapore White, and Bombay onions were soaked for 20 minutes in 1:1000 mercuric chloride solution. They were then washed with sterile water and planted in kerosene cans containing soil which had been autoclaved for two hours at 15-pounds' pressure.

[7] The type of conidia primarily used by the writer in comparing the Philippine onion bulb rot *Fusarium* with other species of this genus is the 3-septate conidia as they form the normal type. According to Wollenweber, Sherbakoff, Reinking, Johann, and Bailey (1925) normal macroconidia form the basis for a natural classification.

Two methods of inoculation were used, one was by pouring spore-suspension around the bulb in each hill and the other by inserting the spores into a small wound cut out of the scale plate. Three cans were used in each inoculation. Two were inoculated and the third was used as control. The cans were placed outside of the laboratory where the sun could shine on them only in the morning and at noon.

The two methods of inoculation were equally effective. All the control cans showed 100 per cent germination. Symptoms of infection were shown 7 to 14 days after the foliage emerged from the soil. Inoculation of the bulbs through wounds was more fatal to the plants than by pouring spore-suspension around the bulb (plates I and II). Many of the bulbs which were inoculated through wounds failed to emerge, and microscopic examination of the decayed tissues showed the presence of mycelium and conidia of *Fusarium* much the same as those found in culture.

Yellowing from the tips and then the subsequent dying back of the leaves were the conspicuous symptoms (plate III). In many instances the leaves showed loss of stiffness without conspicuous yellowing. They bent and then they became yellow and soon dried out. Some of the plants whose foliage had dried out were pulled up and examined. Rotting of the bulbs similar to that described under "Symptoms" was observed. The mycelium was found in the decaying tissues. The fungus was recovered in the decaying tissues. The fungus was recovered in re-isolation from the bulb.

Field inoculation. Singapore Red and Singapore White were the varieties used in this inoculation. The experiment was started on February 14, 1927. The plots were watered every afternoon. Two plots three meters long and one meter wide were used for each variety. Onion bulbs which had been previously treated with 1:1000 mercuric chloride solution for 15 to 20 minutes were planted in each plot. They were planted in rows about 25 centimeters apart; 10 to 12 bulbs were placed in each row. One plot was inoculated by pouring the spore suspension around each hill. The other lot remained untreated. About 97 per cent of the bulbs in the treated and untreated plots germinated.

Ten days after the emergence, three plants of the inoculated Singapore Red and six of the Singapore White showed the first symptoms of infection. No plants in the control plots showed any symptom. Twenty days after the first observation about 85 per cent of the plants in inoculated plots died. Those that remained showed signs of infection. Most of the plants in the control plots exhibited symptoms of tip-burns owing to the intense heat of the sun. Some showed symptoms of yellowing similar to those caused by *Fusarium* but after close examination it was found that they were attacked by *Sclerotium rolfsii* originally present in the soil. The sclerotial bodies of this fungus were produced abundantly at the neck of the infected bulbs.

Within five weeks all of the plants inoculated died, while about 80 per cent of the control plants were still alive. Bacteria, nematodes, and maggots were found in the decaying tissues.

Cross inoculation using other bulb-producing plants. *Allium sativum* Linn., *Allium porum* Linn., and *Crinum asiaticum* Linn. were planted in pots and then inoculated through wounds and through soil with the Philippine onion *Fusarium*. No symptoms of *Fusarium* infection were noted in any of the plants.

Relation of soil moisture to the development of disease

An ordinary dry field soil consisting of clay loam was sifted and autoclaved for two hours at 15-pounds' pressure and then placed in 21 new pots of known weights. The holes in the bottom of the pots were closed and the inside surface coated with paraffin by heating in order to cover the minute pores of these earthen containers. The water-holding capacity of the soil was determined and was found to be 29 per cent of the weight of the dry soil. Selected bulbs of Singapore Red onion were sterilized with mercuric chloride (1:1000) for 20 minutes and then three were planted in each pot. Based on the water-holding capacity, the following moistures were used: 10 per cent, 30 per cent, 50 per cent, 70 per cent, 85 per cent, 95 per cent, and 100 per cent. In each moisture three pots were used, two were inoculated and the third remained as control. The loss of weight of the pots was restored every day by the addition of water.

After 10 days the young plants emerged except those in 10 per cent moisture where the soil was dry. In this moisture the plants emerged some days later.

Symptoms of infection were first noted in 30 per cent and 95 per cent moisture two weeks after emergence of the plants but only one plant in each showed the disease. Three weeks later these plants seemed to have general *Fusarium* infection (plate IV). The plants in 70 per cent showed the heaviest and most rapid infection followed by 50 per cent, 85 per cent, and 30 per cent, then by 95 per cent. The plants in 100 per cent were the last to show the symptoms of yellowing and dying-back of the leaves. No *Fusarium* infection was observed in 10 per cent moisture except that later the foliage showed tipburns.

The control plants were vigorous except those in 10 per cent and 30 per cent moisture where they were small and slow-growing. The poorest plants were produced in 10 per cent. The best plants were produced in 70 per cent, followed by those in 85 per cent, then by 50 per cent, 95 per cent, and 100 per cent, and then by 30 per cent. All the control plants were disease-free for two months after which they were affected with tipburns. The same behavior of growth was also shown by the plants in the inoculated lots; in the first few weeks only a few plants were infected.

From this limited trial it was found that the optimum soil-moisture requirement for the parasitism of the Philippine onion *Fusarium* lies between 50 per cent and 85 per cent of the water that the ordinary field soil in the College of Agriculture at Los Baños can hold. The plants grow in between 50 and 85 per cent. It seems evident that the optimum soil-moisture requirement for the growth of Singapore Red onion lies close to if not the same as the optimum for the parasitism of the *Fusarium* under investigation. Where the high moisture contents of the soil affect the growth of plants a little, the aggressiveness of the parasite is also correspondingly slightly reduced. Where dryness causes general stunting of the plants, the parasite can not produce the disease.

LIFE HISTORY OF THE PHILIPPINE ONION BULB ROT FUSARIUM IN RELATION TO PATHOGENESIS

Method of living over from season to season

In a very advanced stage of rotting, especially when desiccation is rapid, hyphal and conidial chlamydospores are produced. The onion refuse left in a *Fusarium* infected field may be loaded with spores. With the disintegration of the tissues they are liberated and are subsequently spread by certain natural agencies. The chlamydospores are provided with sufficiently thick walls with which they can resist adverse environment. When a favorable season comes, they germinate and start another infection in the field. In the Philippines, bulbs are used for propagation. The native planters do not pay much attention to bulb selection for the next planting season and in many instances they get them from *Fusarium* infected fields. The bulbs, although healthy in appearance, may have the mycelium in the tissues without causing any perceptible rotting, and soil particles that adhere to the bulbs may contain the spores. The mycelium in the tissues and the spores form sources of inocula for a subsequent storage or field infection. The writer believes that under certain conditions the Philippine onion *Fusarium* is capable of living as a saprophyte. Parasitism is established only when it comes in contact with its host under favorable weather and soil conditions.

Method of dissemination

The fungus is spread by the transportation of diseased sets from one place to another. The spores may also be carried by surface wash during heavy rains. Tools and implements also scatter the fungus. In Batangas, particularly in Lemery and neighboring towns, whirlwinds are frequent in the dry months of March and April. The whirlwind not only raises the dust in the fields several hundred feet high but transports it to distant places, and the writer believes that spores may be spread with the dust. It may perhaps be possible that insects breeding in the rotting tissues of the onion bulbs also spread the parasite.

Method of infection

Link and Bailey (1926) report that all the pathogenic species of onion *Fusarium* are wound parasites. Pot inoculations using wounded and unwounded onion bulbs showed that the Philippine parasite is capable of infecting both uninjured and injured onion bulbs. Wound inoculation, however, is more readily secured than by pouring spore suspension around the unwounded bulb. It is probable that the common method of infection in the field is through insect injuries in the bulb.

CONTROL

Sanitation

Where a slight infection has started in a small portion of the field it is advisable to pull up the plants for a meter around the point of infection. Then cover the infected area with inflammable materials and burn them to kill the causal fungus. This will prevent the spreading of the disease and infecting of the whole field. All of the trash and onion refuse should be burned after harvest.

Crop rotation

A long crop rotation in which no *Allium* species is planted should be practiced in an onion field infected with *Fusarium*. This will give no chance for the parasite to develop and multiply.

The following farm practices in relation to disease control are based on Walker's recommendations (1919):

Sorting onion bulbs

Bulbs which show signs of disease, insect injury or growth of fungi which do not even cause decay should be discarded. The growth of fungi which do not cause bulb rot weakens the onion bulb and makes it readily susceptible to rots.

Harvesting, curing, and storing

Harvesting should be done when the weather is dry and clear. High humidity favors the development of many onion diseases. Bruising and removing the tops down to the living tissues offer an avenue to an infection of bulb rot fungi.

It is necessary to lessen the moisture in the bulbs during their dormant stage by allowing them to "sweat", or cure. Moisture in the bulbs is conducive to the growth of fungi. Onions are allowed to cure by piling them in open sheds or in the field. If piled in the field temporary roofs for protection from rain should be built.

The onions should be stored in a clean dry house. Good ventilation should be provided. Since there is no very cool weather in the Philippines artificial heating is unnecessary.

SUMMARY

1. A bulb rot of onion caused by a species of *Fusarium* occurs in Lemery, Batangas, and probably also in other onion growing regions in the Philippines.

2. The symptoms are rapid yellowing or wilting of the leaves. The affected leaves dry out rapidly. When pulled up the bulbs show a semi-watery decay. The symptoms are identical with those given by Walker and Tims (1924) for the *Fusarium* bulb rot of onion in the northern Mississippi Valley.

3. The loss due to this disease in Lemery is about 40 to 60 per cent. The most important causal agent of onion bulb rot is a fungus belonging to the genus *Fusarium*.

4. The onion bulb rot *Fusarium* in the Philippines is somewhat similar to *Fusarium zonatum* (Sherb.) Wr. forma 1 and is considered by the writer as belonging to this variety.

5. This fungus shows more profuse growth on agar media containing dextrose than on those without this sugar.

6. Pot inoculations were readily secured through wounds and by pouring spore-suspension around the unwounded bulbs in the soil.

7. The disease develops in a variety of soil moisture content ranging from 30 per cent of the water-holding capacity of the soil to saturation, but the parasite is more virulent at 50 to 85 per cent than at any other soil moisture.

8. The disease is easily controlled by crop rotation and strict sanitary measures.

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PLATE I

Fig. 1 and 2. One-month old Singapore White onion. The bulbs in IN_2 were inoculated through wounds and in IN_1 by pouring spore-suspension in each hill. The leaves of the affected plants show loss of turgidity or yellowing of leaves. The checks CH_2 and CH_1 show excellent development of the foliage.

PLATE II

Fig. 1 and 2. One-month old Singapore Red onion (Fig. 1) and one month old Bombay onion (Fig. 2). Note the difference between plants inoculated through wound IN_a and IN_x and those inoculated by pouring spore-suspension around the bulbs in the soil IN_b and IN_y. The affected plants show withering and drying of the leaves. The control plants CH_a, CH_b, CH_x and CH_y look very healthy as though absolutely free from any disease; but two weeks after photograph was taken they showed tipburns.

PLATE III

Fig. 1 and 2. Individual plants pulled up from each of the cans shown in plate I. Plant (IN_2) in figure 1 from bulb inoculated through wound and plant (IN_1) in figure 2 inoculated with spore-suspension show dried leaves, soft and rotted bulb scales and roots. The checks (CH_2) and (CH_1) show heavy foliage and well-developed roots.

PLATE IV

Fig. 1 and 2. Relation of soil-moisture to the progress of Philippine onion bulb rot *Fusarium*. Singapore Red onion was used in this experiment. The upper rows in figures 1 and 2 are checks (CH) and the lower rows are inoculated (IN) with spore-suspension. Photographed six weeks after inoculation. All inoculated plants in 70 per cent moisture based on the water-holding capacity of soil were rapidly diseased. No living plant remains standing in this moisture. The plants in all moistures show *Fusarium* infection except in 10 per cent where the plants are short and small but free from symptoms of disease. The checks (CH) show freedom from *Fusarium* infection, highest development in 70 per cent and poorest in 10 per cent.

(All photographs by the Photographic Division, Department of Agronomy, College of Agriculture, Los Baños, Laguna, P. I.)

NOTES ON YIELD OF SOME SPECIES OF COFFEE GROWN ON THE COLLEGE FARM[1]

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Of the Department of Agronomy

Of the foreign species of coffee which have been introduced on the College Farm from time to time, only five so far have given fairly satisfactory results. These are *Coffea excelsa* Chev., *C. Quillou, C. robusta, C. canephora,* and *C. Liberica* (Hiern.) Bull. The failure of the other species is attributed to two main causes. Some of them were killed by the destructive fungus, *Hemileia vastatrix* B. et Br.; others were not adapted to the conditions of the Farm. The five successful species are to some extent susceptible to *Hemileia,* but in varying degrees. Excelsa and Liberica are able to withstand the disease owing to the thickness of their leaves. Infected leaves of these two species seldom fall prematurely from the stem. Robusta, Quillou, and Canephora, because of the delicate nature of their leaves, suffer more from the attack of the fungus.

In many respects Liberica is similar to Excelsa, the main difference being that the berries of the former are much larger than those of the latter but are much inferior in quality. One great objection to Liberica is the difficulty of preparing the berries for the market owing to the thickness of the pulp. It is also less productive than Excelsa.

Excelsa has many good qualities which are not found in Robusta, Quillou, and Canephora. The product is of superior quality. The plant is hardy in nature being able to stand drought and strong wind. In such field operations as weeding and cultivation it is not so exacting as the other species; it grows without much attention. Because of this characteristic this species has gained much favor with coffee planters with limited capital. Nearly all the newly established coffee plantations in Lipa, Batangas, are planted with Excelsa. It is becoming very popular among the coffee planters of Laguna also. It is reported to be in such great demand that the coffee nursery of the Bureau of Agriculture at Lipa can not supply the demand for seedlings. The College of Agriculture has been unable to meet the increasing requests for seedlings of this species.

In past years, owing to the destruction of the coffee rust, the coffee planters in Batangas lost interest in coffee culture. Many of them planted their coffee plantations to coconut and citrus. But five years ago upon

[1]Experiment Station contribution No. 553. Received for publication August 10, 1928.

the introduction of Excelsa coffee the Batangas farmers again turned their attention to coffee growing. Now there are a considerable number of new coffee plantations being started. It is very likely that in ten years, Batangas may regain its former prestige as a leading coffee producing province.

As to the yielding ability of these coffees, our records in the College covering a three-year period from 1926 to 1928 show the following: Excelsa gave of fresh berries as the maximum yield a tree, 10.69 kilograms; Robusta, 6.79 kilograms; and Quillou, 6.43 kilograms. These figures are based upon records of 100 trees not included in this report. The average yield of fresh berries a tree in the three years' time was: Excelsa, 2.702 kilograms; Robusta, 1.702 kilograms; and Quillou, 1.645 kilograms. These figures show that the yielding ability of the individual tree of Excelsa is the greatest of the three. According to our determinations the percentage of clean beans based on the weight of green berries is as follows: Quillou, 25.06 per cent; Canephora, 25.0 per cent; Robusta, 23.2 per cent; Excelsa, 17.2 per cent; and Liberica, 10.1 per cent.

In the next two or three years we hope to make a more comprehensive report on the merits of these three species.

Canephora and Liberica have not been included in this determination because we have only a few plants of these varieties in our plantation. However, our records show that they are poor yielders. Also, no mention has been made of Arabica, as it does not thrive under our conditions no matter how much care is given the plants. If attacked by coffee rust the trees are defoliated before they come to bearing. It has been reported, however, that Arabica trees grow luxuriantly in the Mountain Province and in some parts of Mindanao with no sign of the rust.

A WORD OF COMMENT ON GORDON'S GRAVITY GATE[1]

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Of the Department of Agricultural Engineering

WITH TWO TEXT FIGURES

In the gravity gate, what angle should the pivot piece make with the vertical in order to produce the greatest moment? This angle would then be the limiting angle, and while it may not be the most advisable angle, yet it should not be exceeded.

In order to simplify the solution of the problem, let the gate be opened so that its plane be perpendicular to the plane of the gate posts. (See fig. 1.)

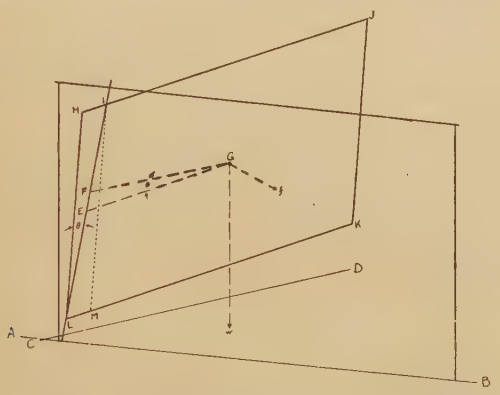

Fig. 1.—Diagram showing the Gordon gravity gate open with the forces acting to close it.

Let the intersection of the plane of the gate posts and the horizontal plane be AB, and that of the plane of the gate and the horizontal plane be CD. Hence the angle $BCD=90°$. The gate makes an angle with the vertical plane through CD equal to Z, the angle which the pivot piece makes with the vertical, as this is really the plane angle of the dihedral formed by the gate and the vertical planes.

The weight w of the rectangular part $IJKM$ (which is the unbalanced weight) is perpendicular to the horizontal plane, and makes the angle Z with the plane of the gate. The effective force f which closes the gate is

[1]Experiment Station contribution No. 554. Received for publication August 8, 1928.

Gordon, Alexander. 1928. A gravity gate, or a simple self-closing gate. The Philippine Agriculturist **17**: 117–123.

the tangential component of w, and is therefore perpendicular to the plane of the gate; its angle with w, at the position of the gate taken, is $90°-Z$.

In the figure, $HL=a$; $HJ=b$; $HI=x$; $FG=y$; $EG=\frac{b}{2}$.

We now have the following equations which lead to the solution of the problem:

$$(1)\quad x = a \tan Z;$$

$$(2)\quad y = \frac{b}{2} \cos Z;$$

$$(3)\quad w = k\, a\, (b-x),$$

k representing surface density;

$$(4)\quad f = w \sin Z;$$

$$(5)\quad M = f\, y.$$

The moment M can now be expressed in terms of Z and the constants. By actual substitution and simplification we get

$$(6)\quad M = \frac{kab}{2}\,\frac{b}{2}\,(-\sin 2Z - a \sin 2Z).$$

Differentiating and simplifying we have

$$(7)\quad \frac{dM}{dZ} = \frac{kab}{2}(b \cos 2Z - a \sin 2Z),$$

and this is now put equal to O to get the maximum value of M.

We then get

$$(8)\quad \tan 2Z = \frac{b}{a}.$$

From this we see that the limiting angle, i. e. the angle giving the maximum moment, is one-half of the angle which the diagonal of the gate makes with the vertical. Fig. 2 shows this.

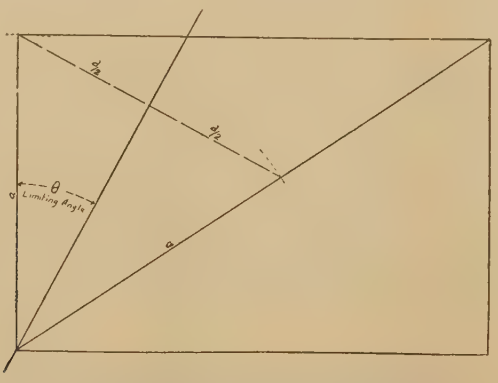

Fig. 2.—A diagram showing how to find the limiting angle for a Gordon gravity gate.

Possibly the most advisable angle would be about one-half or less than one-half of the limiting angle. Doctor Gordon gives 5° to 10° as the most advisable angle for ordinary gates. In the almost extreme case of the gate being twice as wide as it is high, this limiting angle is about 30°, and the angle he advises is still good; his experiments gave him satisfactory speed in and satisfactory force at closing using an angle of 10°, or ⅓ of the limiting angle for such a gate. With a barn door twice as high as it is wide the limiting angle is about 14°; and following his fraction of ⅓, this would come to about 5°. According to Doctor Gordon, these were some of his reasons for adopting 5° and 10° as limits.

ABSTRACT[1]

Corn production as affected by some common manures. Marcelo B. Peña. (*Thesis presented for graduation, 1928, from the College of Agriculture No. 271; Experiment Station contribution No. 555*).—In this investigation the author experimented on: (1) the effect of Complete fertilizer (Big Crop 10-6-2) on the production of corn; (2) the effect of horse manure; (3) the effect of lime and wood ash; (4) the effect of cowpeas as green manure and (5) the effect of soybean as green manure. The work was conducted in the Department of Agronomy, College of Agriculture from 1926 to 1928. Baluga and Calauan Yellow Flint corn were used as seed. The experiment started with lot A which was divided into three plots, the first was planted to cowpeas, the second to soybean, and the third which was not treated served as control. When in full bloom the legumes were plowed under and the three plots were planted to Calauan Yellow Flint corn. Lot B was divided into four plots, each 60 by 28 meters; the four plots, numbered 1 to 4, were divided crosswise into two and the corresponding halves were numbered 1_2, 2_2, 3_2, and 4_2, respectively. The four subplots were treated with lime at the rate of 1000 kilograms to the hectare; the four original plots were not treated. Horse manure at the rate of 5 tons to the hectare was put on plots 1 and 1_2, Big crop 10-6-2 at the rate of 500 kilograms to the hectare on plots 3 and 3_2, and wood ash at the rate of 500 kilograms to the hectare on plots 4 and 4_2. Plots 2 and 2_2 were not treated. Lot C was prepared and treated as lot B with the exception that lot B was planted to Calauan Yellow Flint corn and lot C to Baluga Yellow Flint. The distance used each way was one meter between hills.

The experiment gave the following results: For three plantings, plot 1 of lot A gave an average yield of 293.02 kilograms of husked ears more than plot 2, and 603.42 kilograms more than the control; plot 2 gave an average yield of 310.29 kilograms more than the control. Cowpeas as green manure, therefore, proved better than soybean. Plots 1 of both lots B and C produced less than the control, while plots 1_2 of both lots gave an increase in yield in three plantings over the control. The results obtained in these plots were not very conclusive. Plot 4 of lot B gave an average yield of 165 kilograms more than the control, while plot 4_2 gave an increase in yield over the control in one out of three plantings. Plots 3 of lots B and C gave a higher average yield than plots 3_2 of the same lots. The use of fertilizer did not prove profitable. The use of lime alone did not prove productive; the use of wood ash with lime proved better than when used without lime.

[1] Abstract prepared as part of the required work in English 6, College of Agriculture.

The author observed that more diseased ears were found among the plants that matured early than among those that matured late. In lot B, both plots 4 and 4_2 gave a very high yield of marketable corn. Plots 2 and 2_2 gave the same quality of produce. The same quality of ears was obtained in plots 4 and 4_2, plots 2 and 2_2 in lot B; plots 3 and 3_2 in lot C; and the cowpea plot of lot A.

—*Abstract by Felix N. Camba.*

NOTE: "PREPARATION OF SCIENTIFIC AND TECHNICAL PAPERS"

Thoughtful critical comment is always of interest and usually valuable. The following which appears under "Notes on Books" in the May number of *Journal of the Royal Society of Arts* is of special value as the written output from this College is largely scientific and the book is our guide.

PREPARATION OF SCIENTIFIC AND TECHNICAL PAPERS. By Sam F. Trelease, Associate Professor of Botany in Columbia University, and Emma Sarepta Yule, Head of Department of English in the College of Agriculture of the University of the Philippines. London: Bailliére, Tindall and Cox. 7s net.

It is not difficult to see that the task of a scientific writer is threefold; he must amass a collection of relevant material, by experiment, by reference to previous publications, and by abstract thought; he must select from this mass, and arrange his selection in such a way as to convey the desired impression to the reader; and, finally, he must produce such a manuscript as will give in unmistakable terms the necessary instructions to the printer.

All these aspects of the writer's problem are considered in this little hand-book, though it has naturally not been possible to include very much under the first of the three headings. The authors have had a wide experience in the reading of students' manuscripts, and all their suggestions are worthy of consideration, though on many points it is only to be expected that individual opinions will vary.

It is pointed out very justly that, while the printer cannot be asked to correct any kind of actual error, scientific authors have nevertheless a right to assume that their publisher will employ compositors with some special skill in setting up technical matter.

Many cases occur, in which it is not easy to fix the relative responsibilities of author and compositor. It is unfortunate, for example, that the first numeral is denoted in typescript by the twelfth letter of the alphabet, so that it is possible for a compositor to set up wrongly the chemical symbol of Cl for the element chlorine; but not every chemical writer would agree that it is his duty, as the present authors maintain, to make his typescript in such a manner as to make this error impossible.

Again, it is a little insufficient to remark with reference to algebraic symbols and equations, that these "should be italicized", having just previously explained the usual convention for italics. Unfortunately this convention, of a horizontal line under the letters, is required in mathematics for quite different purposes; and it is both obvious and notorious that for mathematical work there must be an *ad hoc* understanding between author and compositor if complete chaos is to be avoided.

On the whole, however, the advice given is sound and clear, and the book deserves the attention of all who have occasion to publish technical papers.

EXTENSION NOTES

Prepared by Moisés M. Kalaw under the supervision of Professor Inocencio Elayda

More About Pioneering Work

In the September Extension Notes emphasis was laid upon the need for some initial capital for the development of a piece of public land. This emphasis may have raised a question in the mind of some young man interested in pioneering as to whether he dared venture without capital or with very little. Of course this depends upon circumstances, and upon individual or collective initiative.

There are many instances where tracts of public land have been developed with little or no capital at the start. Poor men with strong determination to become independent landowners have taken chances and occupied a piece of public land through a homestead entry or through a caiñgin or residence permit. Where feasible, they walked all or part of the way from their home to the new place because they could not pay for transportation. Or they earned the money for the transportation on the way by stopping over here and there and working a few days for wages. Upon reaching their destination they built a shack on their new land or lived with the nearest settler while clearing a portion of the land and putting up a shelter of their own. Not having ready money for daily needs they found jobs to eke out a living while working sporadically on their homesteads and waiting for their harvest.

When better acquainted with their new surroundings they gradually gave up their wage-earning jobs and turned to hunting, fishing, logging or gathering forest minor products that could be readily sold. Thus, in time, with the land producing more and more farm products and with some additional income they became independent. More time was given to farm work and some help hired and the clearing and cultivation extended. Finally, after a period of five years when they had brought under cultivation most of the area of their land grant they obtained the title to their claim.

Generally speaking this is what we call farming without initial capital or government aid. But it is obvious that there was some sort of initial capital and some earned right along in a haphazard way and immediately put to use on the land.

Then there are men desirous of owning land who take a salaried job in cities or towns with the idea of accumulating some capital for a future farm business. When they have saved enough to cover their initial expenses —transportation to get to the new place and beginning the breaking of the

new land—they start their venture. The trouble with this plan is that many find the accumulation of capital so slow they become discouraged and the lure of sure and pleasant positions is greater than that of pioneer farming. Consequently, they abandon the idea of becoming landowners or buy an established plantation. Thus they increase the number of *absentee landlords* instead of *dirt farmers.*

Although these three types of endeavor are all in the nature of constructive undertakings, one important difference must be borne in mind: That the occupation and development of a piece of public land will mean an addition and substantial increase in the permanent assets of the country while the town job does not.

A Valuable Aid to Homesteaders

One of the hardest tasks of a homesteader in breaking his land is the cutting down of big trees, as the public land is usually covered with lumber trees. Some of the land available for homesteads is under the concession of lumber companies which are entitled to the commerical lumber included in their concession. In this way the land which would have been a virgin forest becomes very easily cultivable. If applicants for homesteads keep their eye on such lands, as is the practice in the Camarines provinces, they will be saving a great expense and effort. A homestead on these concessions can be easily reduced to a clean farm, if the homesteader immediately follows the lumbering operations with the usual process of clearing, that is, cutting the remaining vegetation, drying and burning the trash, letting the big trunks and stumps rot.

Information as to these concessions can be secured from the Bureau of Forestry. Prospective homesteaders should try to inquire from the proper Government authorities about the availability of this kind of land.

But if the place applied for under a lumber concession is not to be logged right away and the homesteader wants to enter the land without delay, he should enter into contract with the lumber concessioner to allow him to log the timber trees for a reasonable consideration. An advantage here is an income to enable him to tide over the period of non-production of newly opened land.

Caution to Applicants for Public Land

There have been cases of homesteads adjudicated to applicants through issuance of Torrens titles which were revoked by the Insular Supreme Court in recognition of the preferential right of a counter claim brought in to the Court before or after the applications were entered. These cases are tragedy, for the revoking of the title means that the homesteader loses the results of five years of hard work and self-denial. However, there seems no help for the situation. The Bureau of Lands assumes no responsibility for the land granted the applicants being free from encumbrances and entanglements.

This is the applicant's own lookout. The entry of any piece of public land by private individuals or concerns and even of any tract of public land reserved by the government for public purposes by proclamation of the Governor General does not in the least preclude private rights established to any portion or the whole of the land in question previous to the entry. In fact in the latest proclamations of the Governor General setting aside public land for government reserves or declaring it open for agricultural purposes, there is a specific proviso to the effect that legitimate private claims are not in the least jeopardized by the declaration.

The College Extension Service takes interest in this matter for the sake of small farmers who go out and homestead public land under conditions described in these "Notes". This service advises, indeed, urges those applying for a piece of public land to make absolutely sure that the land they apply for is free from any counter claim. If at any time this adverse claim is discovered, the thing to do is to settle the matter with the claimant in a friendly way and not in Court. This will avoid delay and waste of money, energy and time and sometimes loss of land.

EXCHANGE NOTES

I am a junior farmer, 14 years old, in the seventh grade in school. I raised pigs for market in 1927. I fattened and sold $200 worth. The first pig I owned I bought with $5 I got for a dog. He was a sure enough runt. That's why I got him for $5. He looked the part, was shaggy and had a long nose and back. My mother always had taught me to try and see something good in every animal that lives. I looked carefully at my own pig. A great lump of disappointment rose in my throat, but I thought, "he has bright, kind eyes, and here's where I begin feeding him five good meals a day."

His nose grew shorter, his hams filled in, giving his back the needed fullness. He grew by leaps and bounds. When he was 6 months old he politely tipped the scales at 250 pounds. I sold him on foot for 18 cents a pound, and got my first $45. I deposited $40 in the bank. With the extra $5 and $2 added, made by selling tomato plants, I purchased a second pig. He grew as did the first one, and in 6½ months he weighed 258 pounds. I sold him dressed for 18 cents a pound. I added this to my bank account. I sold $65 worth of chickens I had raised and made $7 by selling tomato plants.

I had 24 laying hens in 1927. I deposited in the bank $200. It's there yet and this year I expect to add to it. My dad is a real fellow. My pig is not his hog, my calf is not his cow, my colt is not his horse, my bank account is not his bank account. We are pals. I have got acquainted with

him. We are partners in this farming business. I love the farm. I long to be a man. To every boy who reads my letter I will say: Feed your pigs well, and above everything else get acquainted with your father.

—JOHN RENO, *Capper's Farmer.*

Ultra-violet rays, used to prevent the bone disease, rickets, in young children and animals by raising the calcium and phosphorus content of the blood, have a parallel effect on plants. This is indicated by the results of experiments by Herbert C. Beeskow, a graduate student at the University of Chicago.

Mr. Beeskow grew groups of soy bean plants in solutions of known mineral composition. He subjected different groups to ultra-violet radiation for varying periods of time, keeping other groups away from the rays as "controls." Then he dried the plants and analyzed them for calcium and phosphorus. In each case it was found that the irradiated plants had noticeable higher contents of these important minerals than the corresponding unrayed controls.

The effects of irradiation with ultra-violet light were not all beneficial to the plants. Soy beans grown in the greenhouse and subjected to direct ultra-violet raying for as short a period as one minute every other day showed a distinct reddening in the parts of the stem and leaves struck by the rays. In cases where the under side of the leaves was exposed to the rays the reddening action was much more in evidence.

Plants grown in darkness and subjected to the rays showed this red color much more distinctly than plants grown in daylight and permitted to become normally green. Heavy overdoses of the rays simply killed the plants.

—*Science.*

Vitamine B is really triplets. The well known food factor has been separated into three parts, each of which has different effects, according to a report by Charles H. Hunt of the Ohio agricultural station, to appear shortly in *Science.*

Two of the vitamines when fed together cause a moderate rate of growth. When fed alone each of these two causes only a slight increase in growth for a short time. The third, found in residue from which the other two had first been separated, causes when used alone only slight growth for a short period, after which there is a decline. When this vitamine is added to the two others the excellent growth associated with the original vitamine B results.

Further tests showed that this third vitamine has all the characteristics of a vitamine in addition to being able to stimulate the other two so that they cause greater growth than when used alone.

—*California Cultivator.*

Can the stock permanently affect the true heredity characters of the graft? The affirmative answer has often been given. But the results of careful experiment entirely rule out the possibility. The developing graft, which becomes the "top" of the tree, is intimately affected by the kind of stock on which it is placed. The effect, however, is purely physiological. Whatever peculiar specific influence the stock exercises on the graft is due to its exercising root functions for the graft. The graft is not permanently affected. Its true hereditary characters remain unaltered, and if shoots from it were grown on their own roots, they would grow true to the type to which the original graft belonged.—F. L. Engledow, in "Agricultural Research in 1926."

—*The Agricultural Gazette of N. S. W.*

One of the functions of a farm paper is to bring these [new] methods to the attention to the rank and file of farmers. A speaker from the [Agricultural] college can talk to hundreds. A bulletin will be read by several thousands. But the great majority of farmers—more than 150,000 of them in Illinois in the case of PRAIRIE FARMER—depend on their farm paper to bring them this information.

—*The Prairie Farmer* (Illinois).

COLLEGE AND ALUMNI NOTES

Doctor Rebecca Parish, Director of Mary Johnston Hospital, Manila, was the speaker at the third student body convocation. Doctor Parish returned recently from a year's furlough, several months of which she spent in southern and western Asia and in Europe. In her address she took her audience with her from Singapore to Rome accenting not the scenery but the people, especially the trend or awakening in education. Doctor Parish etches her picture clearly and leaves no question in the minds of the audience as to the purpose of the picture.

Dr. C. J. Humphrey, Mycologist, Bureau of Science, was a Campus visitor on August 16 and 17. He went over the higher basidiomycetes in the Baker Herbarium of the Department of Plant Pathology. Doctor Humphrey is an incessant worker, with great interest in Plant Pathology. He talked over with Dr. G. O. Ocfemia of the Department of Plant Pathology the future of Plant Pathology in the Philippines and the control of some of the diseases of our important crops.

Mr. Epifanio Enerva of the class 1924 was a visitor in the College on August 18. Mr. Enerva is now farming in Alaminos, Pangasinan. From graduation up to last year, Mr. Enerva was connected with the San Carlos Agricultural School as teacher. He resigned in June, 1927, to operate his own farm which consists of about 104 hectares. He bought recently 21 more hectares to add to his present holdings. He came to Manila to confer with the Bureau of Lands officials. Being so near he came out to the College to visit old friends and old scenes.

The Los Baños Biological Club held its thirty-seventh scientific program in the Auditorium of the College of Agriculture on September 6, 1928.

The following papers were read and discussed:

"The fisheries of Laguna de Bay with special reference to the problem of conservation and protection", by Dr. Deogracias Villadolid.

"Is the carabao susceptible to tuberculosis?" by Dr A. K. Gomez.

"A report on the 'many-eyed' character of sugar cane", by Mr. Toribio Mercado.

The Mimics presented "Daughters For Sale" by Carlos P. Romulo on the evening of September 22. The characters in the play were interpreted by the following members:

Cast in order of appearance

Don Pelayo	*Agapito Muyargas*
Gregorio, the barber	*Primo Manuel*
Rosario, daughter of Don Pelayo	*Soledad Marfori*
Maria, daughter of Don Palayo	*Candilaria Dionisio*
Amparo, daughter of Don Pelayo	*Emerciana Lorenzo*
Don Juan, a rich land owner	*Francisco Franada*
Aurelio, School of Commerce graduate	*Domingo Tugade*
Mariano, Chinese tienda keeper	*Loreto Valera*
Miguel, graduate from College of Agriculture	*Filemon Español*

The play was directed by Miss Anna F. Cole of the Department of English. The production showed careful and intelligent study and painstaking rehearsals. The Mimics is to be congratulated.

A college atmosphere was created by the playing of our college songs by the orchestra before the curtain rose and between the acts and the spontaneous singing of the songs by the audience. At the last curtain the lively Varsity March gave a final college touch to an excellent student performance.

It was most fitting that this, the opening night for the Mimics this year, should be celebrated by the "first appearance" of the drop curtain, the first in the Auditorium. This curtain was a project started three years ago by Miss Wilson, then director of the Mimics.

The curtain was painted by the College artist, Mr. Villaluz, most pleasingly and artistically. Mr. Villaluz used for his theme in scene on the curtain the view as seen from the Administration Building.

The audience expressed appreciation of the curtain by "three cheers for Villaluz", led by Antonio Flores, College Yell Leader.